PIXEL CITY

a modular pandemic
resilient neighbourhood design

JINGYI MAO

master's thesis, 2021
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Abstract

Background Since the start of the COVID-19 pandemic in March 2020, dramatic changes have been brought into people's everyday life. Unexpected lifestyle shifts, such as working from home and being heavily reliant on online and outdoor activities. With the unknown duration of this pandemic and the future pandemics that we need to face, it is a good time to re-examine our current built environment and imagine a better future.

Methods The goal of this thesis is the propose a modular system that is resilient to future pandemics. To reach such goals, literature review is used as a method to learn related theories. Parallel to theoretical study, international example analysis is used as a method to get insights current practice of modular and communal space design.

Results Based on theories learned from literature review and takeaways from international project analyses, a resilient modular system that is applicable in different sites and contexts is proposed in the last chapter. Finally, the modular system is applied to a real site design where a pandemic resilient neighbourhood is proposed.

Conclusions This global health crisis that we are facing can also be taken as an opportunity for us to re-examine our built environment. Social connectedness can be built with the support of careful designs of different communal spaces. The three levels of flexibility provided in the proposed modular system enable resiliency in apartment, building, and neighbourhood in facing future pandemics.

Related Sustainable Development Goals Goal 3 Good health and well-being, Goal 9 Industry, innovation and infrastructure, Goal 11 Sustainable cities and communities, Goal 12 Responsible consumption and production, Goal 13 Climate action.

Keywords

COVID-19 pandemic, mental wellbeing, flexibility, resiliency, modular system, communal space, sustainability

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Introduction

the starting point

This thesis started from my own experience of feeling distressed and disconnected during the early phase of COVID-19 pandemic, and therefore the idea of designing a pandemic resilient neighbourhood where social connectedness is existed and residents could interact with one. The final design proposal depicts a community living with tight social connections which is facilitated by a modular building system that is flexible and resilient to spatial demand during pandemic times.

anyone? help!

It was six months after I arrived in Finland to start my study, just when I felt ready to embrace the wonderful life that was about to start, COVID-19 pandemic hits. It is since then our live has changed dramatically, what used to be considered as the most common activities becomes the most impossible: students cannot have classes at school but to study at home, no more studying in libraries, office workers can no longer working from the office, restaurants and museums are closed, travels are banned. In more than one and a half years, countries have gone in and out of lockdowns to protect people from the virus and to ease the virus from spreading. Even though Finland had the first outbreak started late compares to some parts of the world and had kept the infectious number relatively low, there were periods of time when I was afraid to go outside of my 19m² student apartment and make human contacts. Weeks of self-isolation came with the sudden changes of studying modes made me feel overwhelmed and distressed, and I thought I am one of those who enjoys being alone. I didn't take the situation all too well.

life saving views

Luckily, my apartment comes with a window facing to a street, which gives views to the passers-by and what's been happening on the street. There were days I would just sit in front of the window and look at the street, sad as it might sound but I found a sense of connections even by just being a witness of what is happening. I couldn't imagine what those days would be like without the window and the views! It is always the nice landscape scenery that architects try to capture when placing a window as a picture frame on the wall, so does myself. Never did I realise the power of having visual connections to human activities, a street or other apartment window for example, until being physically isolated from other human being, thanks to COVID-19.

can we do something?

This experience got me thinking, what can architects do? If people, even a small fraction of us, feeling lonely and depressed, staying in their homes during pandemic times, is there an alternative way of designing and building houses and neighbourhoods that could minimize the mental distress and even make people feel happy? Therefore, I set this as the goal of this thesis and to dream a wildest dream - a pandemic 'free' wonderland.

'' Where there are challenges,
there are opportunities for change. ''

/ Klanten, R., Stuhler, E., & SPACE10

Index

Chapter 1

Call for a change

How has the COVID-19 pandemic changed people's life? What are the major side effects of corona restriction measures? This capture, from regional and worldwide studies, looking for pictures of people's life under this pandemic and seeking insights of challenges that we are facing which are in need of urgent attention. As a starting point, from where the following chapters unfold. This capture is consisted of two main parts. First, mental health under the pandemic and its relation to the built environment; second, major lifestyle changes in the pandemic times and possible 'new norms' in the future.

1.1 Built environment and mental health

what is mental health

Mental health, apposing to physical health, is an essential component of overall wellbeing, which defined by World Health Organization (WHO) as 'a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community' (2018). Effected by many factors, such as genetic predisposition, socio-economic background, childhood experiences, employment, the physical and built environment, it is prior to the COVID-19 pandemic, has the mental health of general population in Europe become a concern (European Commission, n.d.). A document published by European Union (EU) in year 2018, indicates 84 million people across EU are affected by mental health problems, which means in every six people, one is suffered from mental distress (OECD/EU, 2018).

cities & mental health

Cities, with large populations and dense infrastructures that come with high levels of noise and air pollution, potential overcrowding and urban heat islands effects, can pose a higher risk to one's physical and mental wellbeing (Alberti et al, 2019). With an estimation of close to 70 per cent of the world population will live in urban areas by 2050 (UN, 2018), it is becoming an urgent priority that we recognise the role of cities in affecting mental health, study the mechanism behind the effects, and for architects and city planners, take this challenge as an opportunity for creating a built environment that support and promote mental wellbeing.

1.2 Mental wellbeing under COVID-19 pandemic

Hit by coronavirus in the end of year 2019, countries went into lockdowns one after another, measures such as self-isolation, quarantine, social distancing were imposed to ease the spread of the virus and to protect people's physical health. On the other side, however, mental health has become one of the biggest side effects of all the response measures, which often related to mental distress including anxiety, loneliness and depression. This section presents three studies on the effects of pandemic to people's mental health, with focuses on different geographical regions and research groups.

research 1:
loneliness is in rising

Research: Coronavirus: Mental Health in the Pandemic, 2020-
Organization: Mental Health Foundation
Research scale: UK national wide

In UK, researchers from the University of Cambridge, Swansea University, the University of Strathclyde and Queen's University Belfast are working together on an ongoing study called Mental Health in the Pandemic study (2020). Led by the Mental Health Foundation, repeated online surveys were contacted in this study, since mid-March 2020 with more than four-thousand UK adult residents as research participants, of how the pandemic is affecting people's mental health (Mental Health Foundation, 2020).

In their one-year landmark study conducted in February 2021, survey results are analysed and compared with the results from March 2020, the first round of the online survey of the research project. New results of this study show 'the pandemic crisis has dad wide and deep emotional impacts on UK adults' (2021), yet with a mixed picture where anxiety among UK adults shows a falling trend - from 62 per cent in March 2020 to 42 per cent in February 2021 - but the sense of loneliness in rising - from 10 per cent in March 2020 to 26 per cent in February 2021 (Mental Health Foundation, 2021).

Loneliness, a sense of emotion that can be resulted from lacking emotional support or losing connections with other people, such as friends, family, and also with the community and the social environment one lives in. The sense of connectedness, being a key factor to loneliness and a major emotional support for us to seek help when copying with difficulty, it is of a particular important matter that one feel connected with people and their community during a global crisis where we all might felt more vulnerability than usual. However, as the research shows that despite the lifted restriction, the sense of loneliness has not yet returned to its pre-lockdown level (Mental Health Foundation, 2021). Among the survey participants, the study shows that young adults (18-24 year olds), full-time students, people who are unemployed, single parents and those who have pre-existing mental health issues are significantly more likely to suffer from mental distress, comparing with general adults in UK.

However, as the state of one's mental wellbeing it a reflect of their emotional response to all the happenings in one's life and the world, it is also affected by other crises that happening to individuals, countries, and the world, therefore, considers must be taken into account that there might be other major factors that contributed the results in this study.

research 2:
young adults as a
vulnerable group

Research: Loneliness, worries, anxiety, and precautionary behaviours in response to the COVID-19 pandemic. 2021
Research scale: UK and Northern European countires

To identify the most vulnerable population subgroups in facing different public-health measures during the COVID-19 pandemic. In this research, a series of survey data from 7 studies of over two-hundred thousand indi-

viduals from 4 countries - Denmark, France, the Netherlands, and the UK - are analysed (Varga et al, 2021).

The study shows a consistently high level of COVID-19-related worries in all four countries, despite the different public-health measures taken by each country. Netherlands, with seven per cent of research participants reported suffering high levels of loneliness, being the country that has the lowest loneliness rate compare with other three countries with rates between thirteen to eighteen per cent. However, young adults and individuals with pre-existed mental illness expressed the highest levels of loneliness, in all four countries (Varga et al, 2021).

research 3:
restricted social interaction as a leading cause

Research: COVID's mental-health toll: how scientists are tracking a surge in depression. 2021
Research scale: Global-wide

In a Nature published article, where the author gathered and compared the results of a number of international studies which goal is to investigate how this pandemic has affected people's mental health and what control measures particularly have the biggest impact to our mental wellbeing, and therefore to inform future management of this pandemic (Abbott, 2021). On the other hand, from architectural point of view, this article gives an insight for space making for the future where pandemics as such might happen again.

Survey data from the US Census Bureau and studies from UK all show significant increases of depression and anxiety during the last year, from more 11 per cent reported anxiety or depression in previous year to more than 42 per cent in year 2020 (US Census Bureau, 2020), so does similar picture show in studies from other parts of the world. Such situation predicted by Launa Marques - a clinical psychologies at Harvard Medical School - might not return to normal in a short time.

According to Marcella Rietschel, a psychiatrist at the Central Institute for Mental Health in Mannheim Germany, restricted social interactions and the fear of illness might be the leading cause to mental distress such as anxiety and depression, among the COVID-control measures.

1.3 Lifestyle change during the pandemic

working from home as a 'new normal'

Working from home, as a workstyle that minimise the risk of virus exposure and enables continue working, has become an important way of working for many employees in numerous industries since the start of the pandemic (Bonacini, Gallo & Scicchitano, 2020).

A Japanese study, in which data from surveys that were conducted from June 2020 to July 2021 regarding to changes in working from home during the pandemic was analysed, indicates that despite the increasing productivity of working from home, 10 per cent more than the past year - it is still about 20 per cent lower than working from the office (Morikawa, 2021). This study also reveals a substantial increase of the percentage of employees who want to continue working from home frequently after the end of the COVID-19 pandemic and, therefore, suggesting a potential 'new norm' of workstyle in the future (Morikawa, 2021).

Similar results are shown in another study in which Italy was selected for its case study (Bonacini, Gallo & Scicchitano, 2020). According to the researchers, it is highly likely that working from home will be a 'new normal' way of working in the foreseen future, as the duration of the pandemic and future contagion waves remain uncertain.

changing relationship with nature

ourdoor leisure activities

A survey conducted in June 2020, by the Finnish Environment Institute and the Ministry of the Environment, shows changes are appearing in the relationship between Finnish residents and nature due to the public-health measures, such as social distancing, and fewer choice of leisure activities, which lead to people turn to outdoor activities and nature (Yle, 2020).

Young adults (18-25 year olds) among over 1000 participants, according to the survey, show the most profound changes on views with nature, including increasing placed value and more spent time. On the other hand, declines are shown among participants over the age of 45. Over 50 per cent of surveyed said they spend more time outdoors than they used to; almost half of the respondents reported the frequency of two to three times a week of spending time in forest for other natural areas (Yle, 2020).

This survey also reveals that activities such as mushroom picking and nature excursions are popular among the participants, through which they can seek calmness. The survey also shows a significant increase of popular of outdoor activities among students (Yle, 2020).

Chapter 2

Theoretical backgrounds

In literature, this chapter looking for potential answers to the challenges that were investigate in the previous chapter. The concept of shared living, mostly refers to shared indoor space in the following text, is introduced as an architectural approach to react to the mental health issue posed by COVID-19 pandemic. Then, the changing role of home space - from a space that is priority for one's personal life to a space that needs to host also work and study life - led by sudden changes of our life routine under pandemic times, calls for more flexibility within our apartment space. To realize the above-mentioned spatial characters, and to make it possible to apply such spatial system in different site and context, modular architecture is chosen as the design and building method for this project. Finally, in conclusions part summarized the learnings and takeaways of this chapter.

2.1 SHARED LIVING & MENTAL WELLBEING

why shared living

The increasing mental health issue, being one of the biggest side effects of lockdowns and social distancing which are introduced as methods to protect us from COVID-19, raise the question: can built environment better support our mental wellbeing? According to Grace Kim, the architect of Capitol Hill Cohousing project, Michael Birjaer, an analyst at the Happiness Research Institute (HRI), and Itai Palti, an architect and fellow at the Centre of Urban Design and Mental Health (UD/MH) and founder of the Conscious Cities movement, the answer is yes (SPACE 10, 2018). Although there are many reasons that forced the trend of shared living, such as high living cost and the size of the apartments is getting smaller to balancing out the high housing price per square meter, which made many urban dwellers to seek other forms of housing. Yet, in this study, what I'm interested in is the positive effects shared living, enabled by certain forms housing and spatial design, could bring to our mental health.

how shared living could improve mental health

In a long time, mental health and wellbeing have not been the focus of urban developments as some measurable counterparts, such as transportation and physical accessibility, but as we experience more and more emotional and psychological challenges, including social isolation and loneliness, their impacts to our mental wellbeing have gained growing awareness (SPACE10, 2018). Loneliness, explained by Jeremy Nobel of the Centre for Primary Care at Harvard Medical School, as 'the gap between the social connections you would like to have and the ones that you feel you do have' (Harvard University, 2020, 0:10). The practice of social distancing and self-isolation kept our body safe from the coronavirus, however, its side effects on our mental health as a result of ever-increasing experience of loneliness during pandemic, makes the issue hard to ignore. To navigate such emotional stress, according to Nobel, is to increase one's sense of connection to others and to itself (Harvard University, 2020, 0:35).

key spatial elements and qualities that build social connectedness

Although a lack of privacy caused by poor design in shared living spaces such as over-crowded accommodation and high rents can increase the mental distress, with careful planning and spatial design, Palti explains that shared living 'has the potential to create new meaningful social connection through a network of potentially supportive friends, which decreases social isolation and is therefore beneficial both for our individual and collective mental health' (SPACE10, 2018).

<u>why this study</u>

In a field study down by Greece Kim, cofounder of Schemata Workshop whose cohousing project 'Capitol Hill Urban Cohousing' is later presented

TABLE 2.2: SUMMARY OF COMMON HOUSE FEATURES

	Ådalen 1	Ådalen 2	Andedammen	Bakken	Blikfanget	Bo90	Drivhuset	Ibsgården	Jerngården	Jernstøberiet	Jystrup Savværket	Kæphøj	Klien	Lærbjerg Lod	Munkegård	Overblik	Sanct Hans Gade	Skråplanet	Stavnsbåndet	Sættedammen	Trudeslund
Size including cellar m^2 / ft^2			328 / 3,530	565 / 6,081			493 / 5,306	347 / 3,735	187 / 2,012	490 / 5,274				840 / 9,041				359 / 3,767	355 / 3,821	300 / 3,229	632 / 6,802
kitchen	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
dining room (dr)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
central mail area	x	x		x		x	x			x	x		x		x		x				
bulletin board	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
shared laundry	x	x	x	x		x	x	x	x		x	x	x	x	x		x		x	x	x
guestroom	1	1		lib			tv		tv	tv	2				kr				1		
sitting area/tv lounge (sa/tv)	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x
music room (mr)				x				dr	dr	x			dr	kr		dr				tv/dr	x
game room				x		dr	cs	x			x	x	x	x	dr			x	x	x	x
computer room											x										
library (lib)				x				x					sa							tv	
office				x		x		lib			x									tv	
meeting / multipurpose												x		x							
craft room				x																	x
wood/workshop	x	x		x				x	x	x	x	x	x	x				x	x		x
bike storage	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x
kid room (kr)			x	x		x		x		x		x	x	x	x				x	x	x
teen room								x	tv		x		x		x				x		x
fitness														x							
teen apartments	2	2				2	4				2	3	3								
community store			x				x	x			x								x		
common storage / pantry	x	x		x		x	x	x	x		x	x	x	x	x				x		x
individual storage lockers	x						x		x					x							x
covered street (cs)	x	x					x			x	x										
shared gardens	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x
shared animals				x											x						
landscaped public path or court	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
common patio / terrace	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
play structure / sandbox	x	x			x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
clothesline	x	x					x	x	x	x			x	x	x		x				
central heating plant	x	x				x	x				x				x					x	
recycling center								x			x	x			x					x	
swimming pool / sauna														sauna				pool			
covered parking										x				x						x	x
surface parking	x	x	x	x	x			x		x	x	x	x		x	x		x	x		

↑ Figure 2.1.1
Common spatial features shared by 21 projects.
Source: Grace Kim

in this thesis, she visited and investigated 21 cohousing communities in Denmark, relying on the data she obtained through her social-investigation approach, she summarized and conclude those spatial qualities and different spatial allocations that build the sense of Communitas – a Latin word nicely referred by Kim as 'an intense community spirit exemplified by feelings of social equality, solidarity, and togetherness' (2006, p. 1), which is a key antidote to the mental distress caused by loneliness, a sense of emotion shared by many of us, especially during pandemics. Although the concept of cohousing is not explored in this thesis, as an architecture expression of the 'social response to a lack of community' (Kim, 2006), the spatial qualities of common spaces shared by successful cohousing projects, which been summarized in her book Cohousing Common House Design, gives an insight of what public spaces are desired by communities and what space might in practice forge the sense of social connectedness, which align with what I set out to achieve in the Kaitaa project. Therefore, it was studied as a reference to the spatial elements that are going to be implemented in the design proposal.

spatial elements

36 spatial elements are identified in the 21 cohousing communities, see Figure 2.1.1 (Kim, 2006). Among which features: kitchen, dining room, bulletin board also known as information board, bike storage, landscape public path and court, and common patio and terrace are shared by all 21 to 20 projects; shared laundry room, shared gardens, and play structure and sandbox for children are shared by 18 different projects respectively; some other popular functions but not shared by as many projects as those mentioned above are: game room, wood workshop, common storage room, clothesline, and surface parking.

spatial qualities

Referencing to Christopher Alexander's book, A Pattern Language, 32 spatial patterns for common houses were highlighted by Kim, including the spaces that play a key role in community, tips on spatial allocations, some essential spatial programmes, key patterns for certain elements as well as some interior details, see Figure 2.1.2. Based on her analysis, diagrams of each spatial qualities are made, transformed description text into spatial language, see Figure 2.1.3.

Patterns for a Common House

Role within Community		
	1	Activity Node [30]
	2	Local Town Hall [44]
	3	Main Building [99]
Site Planning		
	4	Centrally Located Common House
	5	Degree of Publicness [36]
	6	Local Centers
	7	Gatekeepers
	8	Community Street
Program		
	9	Communal Eating [147]
	10	Eating Atmosphere [179]
	11	Cooking Layout [184]
	12	Production Kitchen
	13	Central Bulletin Board
	14	Community Store
	15	Social Hall
	16	Guestrooms
	17	Connected Play [68]
	18	Teenager's Apartments [154]
	19	Bulk Storage [145]
	20	Community Laundry
Key Patterns		
	21	Common Areas at the Heart [129]
	22	Alcoves [179]
	23	Spatial Hierarchy
	24	Ceiling Height Variety [190]
Design		
	25	Public Outdoor Room [69]
	26	South Facing Outdoors [105]
	27	Light on Two Sides of Every Room [159]
	28	Window Place [180]
	29	Windows Overlooking Life [192]
Details		
	30	Acoustics
	31	Lighting
	32	Seating

← Figure 2.1.2
Spatial qualities for Common House summarized in her study.
Source: Grace Kim

2.2 FLEXIBILITY & PANDEMIC RESILIENCY

sudden changes in our daily life

According to Marani et al., their study Intensity and Frequency of Extreme Novel Epidemics (2021) indicates that future pandemics will happen with a high probablility of double the changes of individual experiencing pandemics silimilar to COVID-19 in coming decades. The COVID-19 pandemic that we are living under, by the time this thesis is written, has lasted for almost two years since its origin. Sudden changes happened in our normal lives in an unexpected way, things and activities that couldn't seem more normal become impossible - school are closed and students are having class at home, office workers are advised to work from home, public facilities are closed so do restaurants and gyms, public live events are cancelled or moved to online, physical distance needs to be kept from other human beings, and the list goes go. All the above are due to the key factor that COVID-19 is a air-born virus and it is through human contacts spread the virus, therefore, reducing human contacts and quarantining those who are unfortunately being effected are what it needs to slower the spreading of the virus.

changes in spatial needs

As a result of the unexpected lifestyle shifts, a large percentage of the current built environments can no longer support our changing needs in this pandemic time, nor do they have enough flexibility to be adapted into suiting the new situation where certain spaces are in surging needs, such as hospitals, apartments with flexible space that could be separate as one or multiple home offices, new types of shared indoor space in terms of scale and allocations, which is designed for small group activities; while some others becoming redundant, such as school buildings, libraries, opera house, gyms, restaurants, offices, indoor places that could hold large public gatherings are been shut down and therefore being unused as a spatial waste.

flexibility: always ready for the unknown

The described situation is our reaction to this specific pandemic, yet the scenario could be quite different in future ones that are caused by different viruses which spread in different ways and posing threats in other unexpected aspects of our life. Therefore, to prepare spaces for unknown crisis of its occurring time and location, what quality should the space acquire? One answer could be *flexibility* which defined in this thesis by the author as a spatial quality that obtained from the right room dimensions, proper choice of building structure and considerable placing of those relatively fixed room programmes, such as staircase, bathrooms and kitchens, which enables the space to be easily changed in either its usage or size, or rather in both.

With the quality of flexibility, when the spatial scale went from rooms to buildings or entire neighbourhoods, the ability to be changed from spatial form A to form B, and vice versa, in and among the rooms, making the spatial body formed by those rooms resilient - being able to adapt to one scenario to another within one building life cycle, only in this case, the scenarios are not referred as normal and special situations, but current and future unknown times.

resiliency: transform between the unknowns

2.3 MODULAR TIMBER BUILDING SYSTEM & SUSTAINABILITY

In year 2019, 38 per cent of total global energy-related CO_2 emissions were produced by the building construction industry (UN Environment Programme, 2020). Cement - a key input in concrete which is the most widely used construction material in the world, and the second-most consumed substance on earth, next to water - accounts for 7-8 per cent of the world's CO_2 emissions (UNEP Global Environmental Alert Service, 2010). With the record high emissions in 2019 from the building sector, and the approaching to year 2050, by which, estimated by the International Energy Agency (IEA), the direct building CO_2 emissions need to fall by 50 per cent and indirect building sector emissions by 60 percent, in order to get on track to net-zero carbon building stock (UN Environment Programme, 2020). This pressing situation calls for careful considerations in design choices, among which construction system and building materials are two aspects that this project mainly focused on, in terms of fighting climate change and reaching sustainability.

why timber

Wood is one of the oldest and environmentally friendly building materials. It produces the least carbon footprint during its manufacture process but unlike other artificial buildings materials, it stored carbon during its growth so therefore accounts for even less carbon footprint in the end (Stora Enso, 2013). Comparing to steel and concrete, the two most used construction materials, timber releases considerably less CO_2 per $1m^3$ of construction material, see Figure 2.3.1 (OOPEAA, n.d.). In Europe, less than two-thirds of volume of wood grown annually is used: with 776 million cubic metres of wood growing in Europe, 490 million cubic metres being harvested, which lefts 286 million cubic metres increases of tress every year (Wood Days, 2018). Similar to the growth situation of forest in the whole Europe, Finnish forests produce considerably more wood than is used, of which about one third is used for wood products and construction (Wood Products, n.d.). Take a mid-size wooden block of flats, for example, which material grows in Finnish forests within less than half a minute (Wood Products, n.d.). After been used in construction, the timber products release back the carbon that had been stored in itself into the atmosphere

through the decomposition progress, which are stored again by new trees, and therefore complete the natural cycle (OOPEAA, n.d.). By taking its advantages of easy manageability, speed and measuring accuracy, and lightness combined with strength, this project explores the potential of timber structure in modular building systems.

why modularity

Off-site construction, where different building parts and components are designed and prefabricated off the site, often in factories, then been transported and assembled on site. Such construction process, which is the key different with its counterpart on-site construction, has led to benefits but also challenges. Modular construction as one of the most efficient off-site construction methods has gained more and more attention in recent years (Kamali & Hewage, 2016). With the objective of creating a resilient pandemic community, this project seeks for design and construction methods that are sustainable, flexible, and adaptable to different sites and times, with as small intervention to the environment as possible. Known for its light intervention to the site, flexibility in allocations, and its wide application to different types of building functions, modular construction caught my attention at the first place. In compare with some of the most used construction methods, in this part I look into its advantages and disadvantages, in terms of the above-mentioned aspects.

benefits of modular construction

In the study done by Kamali and Hewage (2016), where they compared benefits and challenges of modular construction with other construction methods, through reviewing 106 documents, in total, including book, thesis, journal article and government report. Environmental performance, as one of the most significant dimensions leading to sustainability (Kamali & Hewage, 2016), is evaluated, in this study, by examining life cycle performance of each building methods. It is concluded that 'on average, modular buildings have been shown to provide a better life cycle performance'. The authors first discussed the benefits of modular construction. Parameters include time, cost, on-site construction safety, product quality, productivity and environmental performance are summarized, see Figure 2.3.1, where modular construction shows better performance over on-site construction methods:

Time saving. Owing to the nature of off-site construction where site work and off-site building parts manufacture can go hand in hand, one of the most important benefits of modular construction is time saving (Kawecki 2010).

Possible cost reduction. According to a study by the Construction Industry Institute (CII), some modular construction projects can save up to 10% on overall cost and 25% on the on-site labor cost (Haas & Fagerlund, 2002). However, some literature argues for differ, due to a variety of contributing variables such as project management and transportations (Kamali & Hewage, 2016).

Better on-site safety. As 85 per cent of modular construction is done off site, the on-site reportable accidents can be reduced by 80 per cent, according to a study done by Lawson, Ogden and Bergin (2012).

Higher product quality. Due to the controllable manufacturing facilities as well as construction environments, higher product quality can be achieved by using modular construction method (Cartz, Crosby & Symonds, 2007).

Higher productivity, less workmanship. Unlike on-site construction, which requires relatively high workmanship skills, modular construction and prefabrication, which relies more on automated machines, simplifies the operation process, and therefore stables the workforce and increases the productivity (Celine, 2009).

Better environmental performance. As a result of off-site construction and factory manufacturing, construction waste can be reduced by making precise material purchasing and cutting, planning, and appropriate recycling (McGraw-Hill Construction, 2011). The nature of modular units allows for disassembling, relocation and refurbishment, which extend the life cycle of the material instead of disposal as the conventional buildings would (Li & Li, 2013). Another advantage of modular construction comparing to the on-site construction is its minimal project disturbance to the neighboring area as most of the construction is finished in factories and it only requires assembling on site.

challenges of modular construction

In the same study, Kamali and Hewage (2016) summarized some challenges, through literature review, that modular construction is facing.

Intensive project planning. One of the biggest challenges, pointed out by the author, is the intensive pre-project planning and engineering which is required before the whole process of prefabrication, preassembly and modularization. Different from conventional design, modular design needs a lot more ahead of time consideration of its components, their combinations and transportations, before the modular manufacturing. It is less likely to make adjustment once the manufacturing starts (O'Connor, O'Brien & Choi, 2016).

Transportation restraints. Another challenge comes with many of the benefits of modular construction – being manufactured off-site, transferred to site and assembled on site – is that the dimensions of the buildings parts

and modular systems are heavily restricted by the logistic limits. A design challenge rather than construction one, the designer would face in the design process. Therefore, investigations of the transportation limitations of the area should be conducted before any design steps (Jameson, 2007).

Negative perceptions. The third challenge mentioned in the study (Kamali & Hewage, 2016), as it has been noted in much literature, is the negative perception of the off-site construction methods from the publics. Being often associated with low-quality, temporality and poor esthetics, which is not necessarily the case, modular construction is still on its way of turning around its public's perception by showcasing its benefits and different possibilities that come with the ever-advancing technologies.

Site constraints. Modular construction services may vary from area to area. Two factors that affect clients' choice from modular construction are labor cost and availability of modular experts in the area (Kamali & Hewage, 2016). This building method might not be considered if the local labor is cheap, for it mitigates its benefit of cost saving (Jaillon & Poon, 2010). On the other hand, the lack of experienced engineers and designers on modular systems in certain area can also be a barrier (Mao, Shen, Pan & Ke, 2015).

modular timber consturction & sustainability

Using cross laminated timber as building material which enable the use of wood in multistory buildings, and modular construction as building method which has better life cycle performance than other building methods, modular timber construction is a sustainable option due to its efficiency in prefabrication, flexibility in spatial configuration, adaptability in different contexts and sites and reusability after life cycle of the building (OOPEAA, n.d.).

2.4 CONCLUSIONS

social connections can be built through different senses

Building a strong sense of social connectedness is one way to fight loneliness, anxiety and depression for those who lives alone or going through quarantines. The knowing of 'you are not alone' and the sense of belonging, to the community for example, is specially needed during pandemic times when we are faced with more uncertainties from outside world, insecurities for health from inside, and together with the sense of vulnerability. To support social connectedness during pandemic times with restricted human contacts, focus was put into vision and smell, the other two among the five senses besides touch. More visual connections of different activities happening in the building, housing block and the neighbourhood, in both indoor and outdoor public spaces, can and should be provided through spatial design. Smell, another powerful sense, yet always been forgotten, can bring back related memories, but also a perfect spreader for events and activities - letting people know something is happening long before the venue reaches one's sight.

reaching pandemic resiliency through spatial flexibility

Flexibility is one essential spatial quality that is referred to in this thesis as the potentials of possible changes in either the usage of a certain space or its size or both, however, it does equalize space with such quality as a huge monospace, on the contrary, it requires careful design of its dimension together with suitable building structure and locating of relatively fixed functions such as bathrooms and kitchen.

modularity as a design and construction method

Modular construction has its advantages in many aspects, time and material efficient, better construction quality and what makes it particular suit for this project - a pandemic resilient neighbourhood design, which goal is to create a system with flexibility and therefore enables the resiliency in the neighbourhood built environment - is the reusability of the building elements, such as walls as slabs, due to their unified dimensions and the support of column-and-beam structure system which allows free dismantling and assembling of those building parts.

Chapter 3

Site analysis

This chapter moves from general inquiries of the ideal forms of shared community living to site specific studies. Starting from analysing the current situation of the site: geographical allocation, its surrounding built environment as well as nature resources. Followed by an introduction of its future planning made by the city of Espoo. Ending with a discussion part where the theories are compared with the Kaitaa context which presented in this chapter, and therefore leads to the design questions.

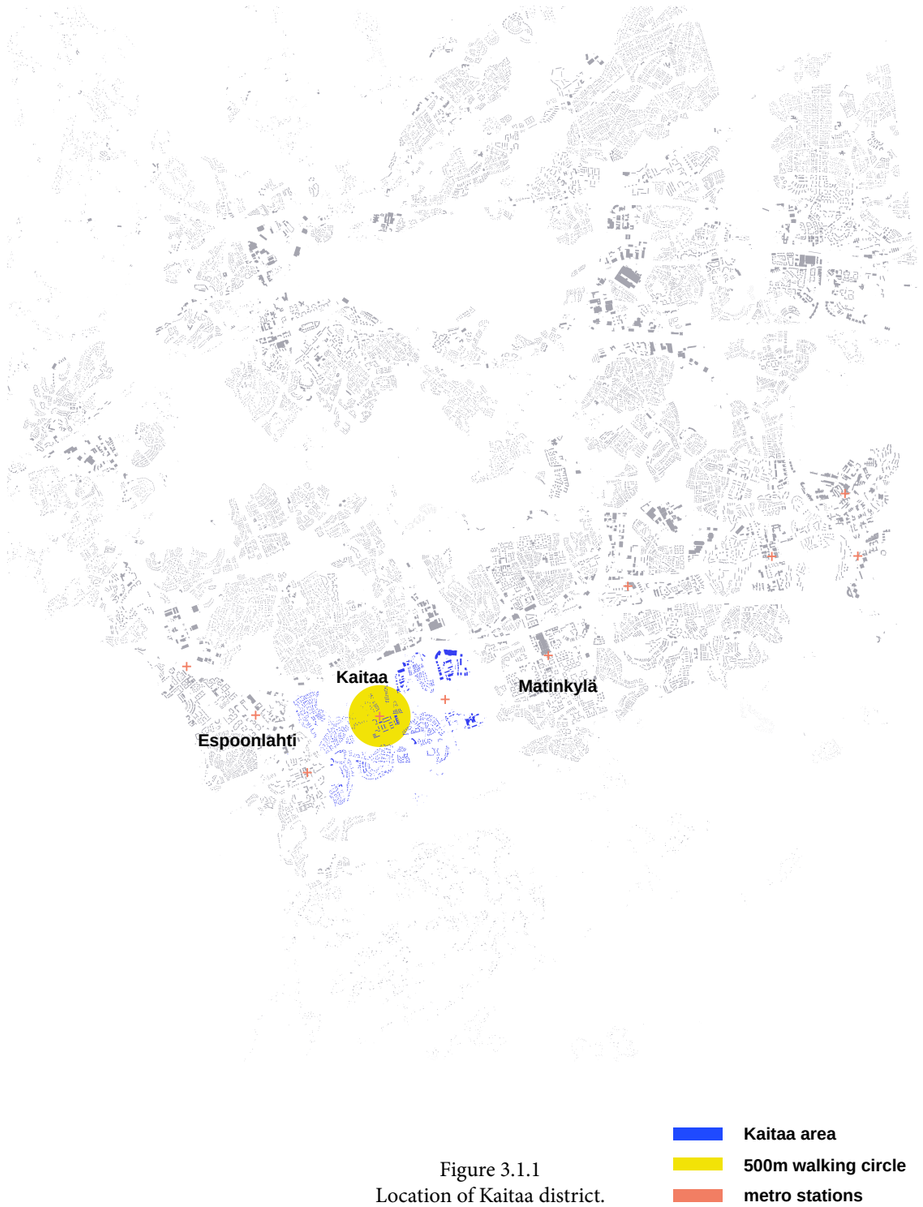


Figure 3.1.1
Location of Kaitaa district.

3.1 CURRENT SITUATION

area overview

Kaitaa district (Figure 3.1.1), east to Espoonlahti and southwest to Matinkylä, is situated in the southeast of Espoo, with an approximately 20 minutes walking distance to the coast. Divided by Kaitantie, most of its northern part is occupied by forest Hannusmetsä, with single family houses scattered along the forest paths. Adjacent to Kaitantie is lake Hannusjärvi, size 60,000 m2, the water body is a natural element that is unique to the surrounding inland city districts. It is on the southern side of Kaitantie shows more of an urban character. With a future metro station under construction, the existing housing types in this part of the area are mainly single-family houses and a fel multi-story apartment building.

why this site

<u>great changes brought by the future metro station</u>

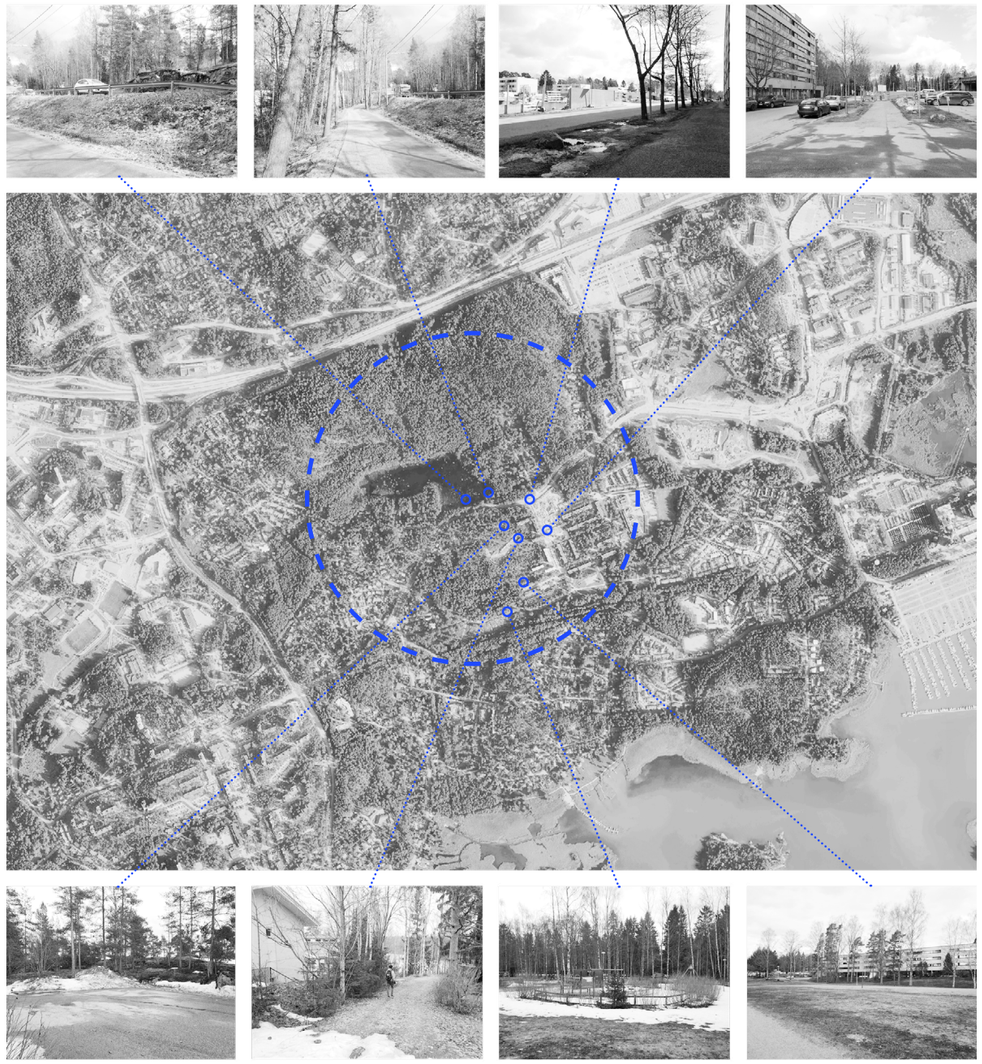
The chosen site, located next to the future metro station, adjacent to Kaitantie, on the south of lake Hannusjärvi, is a small hill with 10 existed single family houses. (Figure 3.1.2-3.1.3) Without re-inventing the surrounding transportation system, the site is situated within the 500m walking distance (Gehl, 2010) to Kaitaa future metro station which will surely serve as a transportation hub and become the most activated block in the area. By taking advantages of this aspect of the future planning, hopes are cars will no longer be needed for its future residents and public transportation will be their first choice for commute.

<u>unique nature landscape with a local forest</u>

As a foreigner who came to study and found herself fallen deeper and deeper in love with the nature landscape, to me, the image of Finland is never complete without forest, lake, and small wooden houses. So, when starting this project - a pandemic resilient community design - the first voice came to my head is 'let it be in a forest'. Luckily, I found such land in Kaitaa and what makes it even better is that there is also a lake hear by. Last but not least, the final element - small wooden houses - is brought to the picture through my design proposal.

<u>existed urban fabric with great potential for new</u>

It is through my research of Espoo city's future planning for Kaitaa and its neighboring areas, which would be elaborated in the next section, that I came to realize that despite the detailed planning of Kaitaa metro station and its supporting amenities, the site which is next to the metro station area has no master plan from the city but only zoning plans with suggested programs. One the other hand, the features that are characterize by the



← Figure 3.1.2
Aerial photo of Kaitaa area.
Source: City of Espoo

↑↓ Figure 3.1.3
Photos on site.

existed urban fabric, provides context and history that the design proposal could base on.

the boundries

Two boundaries are set in the project, one is for analytical purpose and the second is for the design. (Figure 3.1.4) The first boundary is a circle cantered at the metro station with a 500m radius which is an acceptable walking distance, described by Gehl (2010, p. 121) as 'the magic one-kilometre centre size'. Aiming to prepare for future pandemics when taking public transportations can become a risky activity in terms of infectious, it is key for this design proposal to understand what are the services and amenities that have existed in the area within the walking distance, to which new spatial programmes proposed through the design may complement. Thus, it can be seen as a self-sufficient neighborhood with no need for long distance travels under critical circumstances, and therefore protects the residents' health and keeps a 'normal' way of living under pandemics. The second one sets boundary to the design area, which is decided according to the existed buildings, the location of the exits of Kaitaa metro station, and the plot division ruled by the city.

existed built environment

<u>local services</u>

Based on the data from Espoo Map Service (Espoon kaupunki, 2021), the existing services within the analysis boundary are one middle school, one high school, one daycare, two children' playing areas, one indoor sports hall, one outdoor pitch field and one sports park. (Figure 3.1.5)

<u>housing types</u>

The area is predominantly occupied with one and two stories single-family houses. The exceptions are 6 six-stories apartment buildings on the west side of Iivisniemenkatu, to which east, on the Kaitaa metro station block, exist 9 four-stories height apartment buildings. However, in the future master plan of the metro station block, those apartment buildings are replaced by higher mix-used buildings which will be further elaborated in section 3.2 Future Planning. (Figure 3.1.6)

natural landscape

Taken over almost all the northern part of the analysis area, forest is the main nature element in Kaitaa. Hannsmetsä, starts from the northern side of Kaitaantie, crossing the road and the site, continues all the way to the southern border of the 500-meter circle. Adjacent to Kaitaantie, in the north part of Hannusmetsä lays lake Hannusjärvi, a unique landscape feature shared by no surrounding areas, which makes accessibility to the lake especially important for the residents to enjoy this unique landscape. The site, however, with the advantages of its location - right across Hannusjär-

Figure 3.1.4
Two boundaries are set in the project. One is the analysis area, the other is the design area.

analysis area
design area

Figure 3.1.5
Local services within the walking distance.

indoor sports hall
outdoor sports field
children' play area
schools
site

Figure 3.1.6
Housing types in the area. Dominant by spacious single-family housing, the area only has a few apartment buildings in the centre area.

single-family housing
apartment building
public building
site

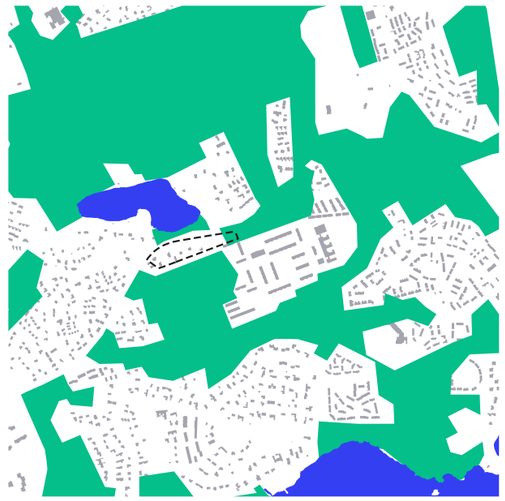
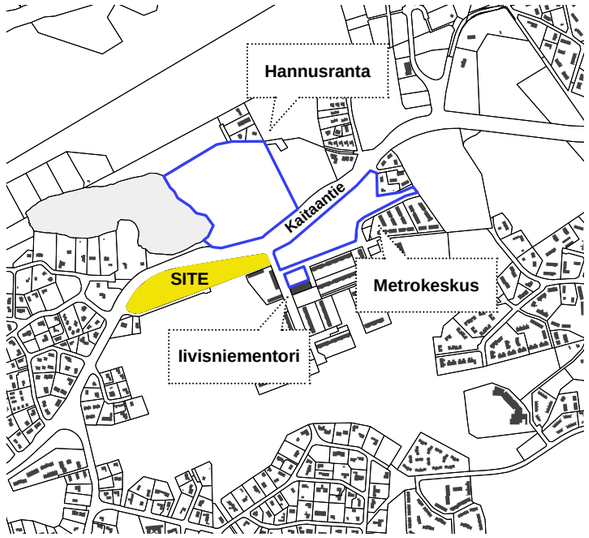


Figure 3.1.7
Natural landscape in the Kaitaa. Greatly covered by forest, with lake Hannusjärvi located in the middle of Hannusmetsä.

forest
waterbody
site



↑ Figure 3.1.1
Kaitaa-Iivisniemi area being one of the future local centers along the metro line.

← Figure 3.1.2
Three planned blocks within the analysis boundary, and their geographical relations with the site.

vi; adjacent to Kaitaantie, a traffic road, which cut the southern part away from the lake – has the opportunity to create connection between two sides and better accessibility to the nature landscape. (Figure 3.1.7)

3.2 FUTURE PLANNING

main objects

The main goal of the future plan is to transform Kaitaa-Iivisniemi area into one of the 'urban housing and business area' along the metro line (City of Espoo, 2018). (Figure 3.2.1) Within the analytical area, three plots are planned by City of Espoo (2020). They are Metrokeskus (metro area), Hannusranta (lakeside area), and Iivisniementori. (Figure 3.2.2) This section investigates the future aspect of the area by presenting the city plans of the above-mentioned blocks.

three planned blocks

metrokeskus

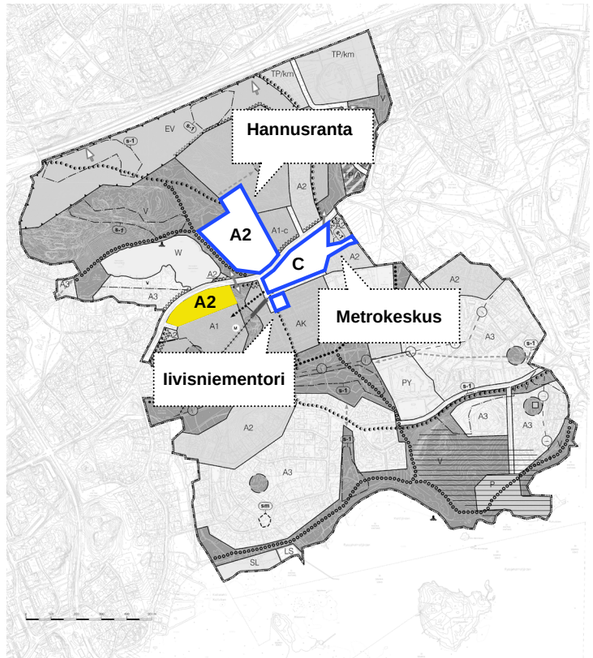
In the Component Master Plan of Kaitaa-Iivisniemi made by City of Espoo (2018), like any other existed metro stations, Kaitaa metro station area - located east to the design site - is planned to be the local centre, with central functions including services, administration, office, education and retail premises (Figure 3.2.3). The city's master plan provides further information regards to the functions' distribution: with the height of eight to twelve floors, most of the new buildings are expected to have mixed functions of residential and commercial usages (City of Espoo, 2018). (Figure 3.2.4)

iivisniementori

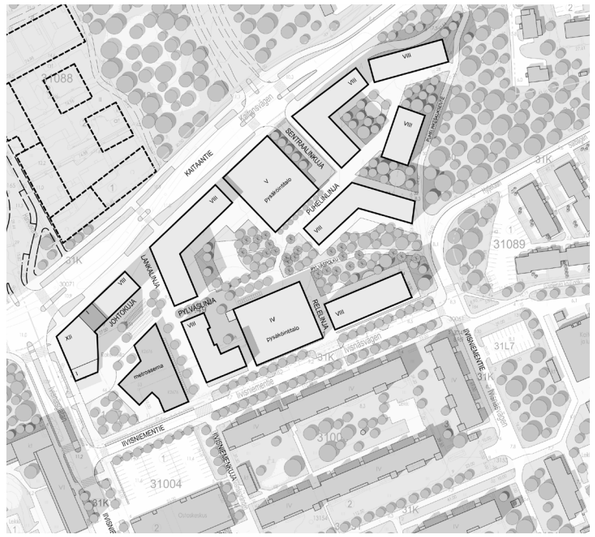
Adjacent to Metrokeskus, on the south side of Iivisniementie, locates Iivisniementori, coded as 31004. See Figure 3.2.5. Being currently the site of a local parking lot, a k-market and a small square, the plot is categorized the same as Metrokeskus - area of central functions - in the city plan. With the location of the square stays the same, this block is planned with residential, commercial and office buildings.

hannusranta

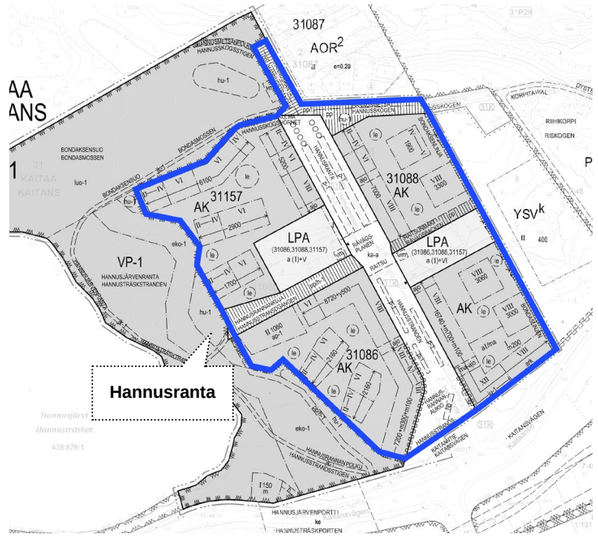
Hannusranta, the lakeside area, which locates on the north side of Metrokeskus and Iivisniementori, is planned as a block of flats. With two parking areas on each side of Hannusranta road and a park on the west side the block (Figure 3.2.6), the apartment buildings are planned in heights between two to eight floors: start with two-floors from the lakeside, and gradually increase towards eight-floors as them follow to the east. (Figure 3.2.7)



Metrokeskus
& Iivisniementori



Hannusranta
The lakeside area



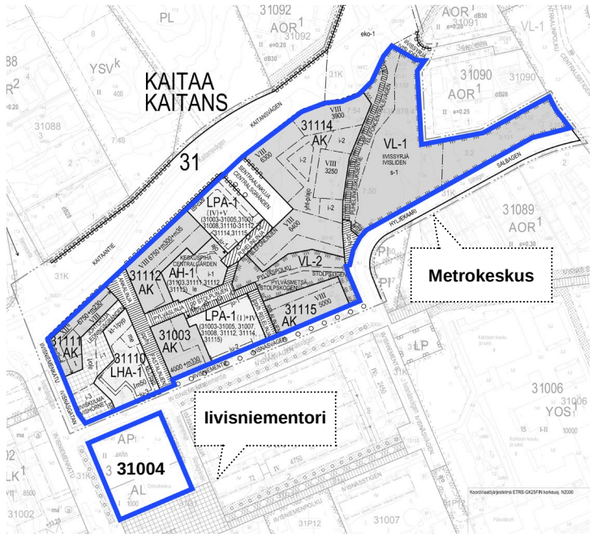
Page 26
↑ Figure 3.2.3
Component master plan of kaitaa-iivisniemi. Source: City of Espoo.

Page 27
↖ Figure 3.2.4
Master plan of metro station area. Source: City of Espoo.

← Figure 3.2.5
Plot code of Iivisniementori and its relation to Metrokeskus. Source: City of Espoo.

↗ Figure 3.2.6
Hannusranta kaava with functions division. Source: City of Espoo.

→ Figure 3.2.7
Master plan of Hannusmetsä. Source: City of Espoo.



the site

The design site locates on the west of the above three blocks. Categorized as A2 in the Component Master Plan (City of Espoo, 2018), the area is described as a 'residential area to be developed'. It is suggested in the plan to have working, service premises, and small business premises located in the area. Remain under study, there is not yet a master plan for this area.

3.3 CONCLUSIONS

spaces for small local business are needed

Undoubtably, with the extension of the metro and together with the future planning, great changes are about to happen to Kaitaa - from a quiet less urbanized and relatively unknown area to a busy lively and more urbanized city district. Among which the metro station area is expected with the most changes. Commercial spaces in those mixed-use buildings provide job opportunities for the locals, convenience of goods purchasing for the residents. However, it is unclear that how much those spaces in the complexes, with relatively high rents, can help small local businesses. It is therefore, in my design proposal, spaces for small local shops are considered - spaces that are smaller than the retail stores in malls but efficient to retail usage, with close locations to the apartments.

an opportunity for new housing types

Likewise, the city's future planning brought mix-used residential buildings with commercial functions. However, it doesn't add the housing types that are already existed in this area. Covered predominately by spacious detached single-family housing, the area has only a few single-used apartment buildings close to the planned metro station area. With the new future brought by the metro line and the COVID-19 pandemic we are going through, it is hard not to imagine the possible new housing type which this area could have, perhaps something that challenges our understanding of the 'norms' as the COVID-19 has been challenging us.

Chapter 4

International examples

This chapter presents four international examples that highlight shared space in different scales and levels of sharedness: from L. - shared by entire neighbourhood - to S. - shared by certain households. In comparison with the site in Kaitaa, which are considered as valuable references for creating shared space in different scales in the design proposal. Each example review starts from explanations of why the project is chosen, followed by brief introduction of its context and backgrounds. Then, key features of the project from the architects with diagrams are presented. Finally, it ends with main takeaways and their influence on the final proposal.

4.1 LIVEABLE, SUSTAINABLE MODULAR HOMES

Project: The Urban Village Project, 2019
Architects: SPACE10 and EFFEKT Architects
Project scale: S.~L. (~m2)

project overview

Envisioned by SPACE10 and EFFEKT Architects, the Urban Village Project is an unbuilt design proposal that rethinks a new way of living together, which manifested by a recyclable modular building system (Figure 4.1.1). Fit into project scales S. to L., it is expected that the flexibility in the modular system would enable itself to adapt to different sites and scales, from individual building scale to larger ones like neighborhood blocks and city centers (Schires, 2019). With the concept Community at heart, it aims to provide a variety of housing types for different households and living situations, from single person studios to multi-generational families. The above-mentioned concepts that are reflected in the project are close to my vision of The Forest Village and also are the reasons for this project to be selected as one of the international examples.

why this project

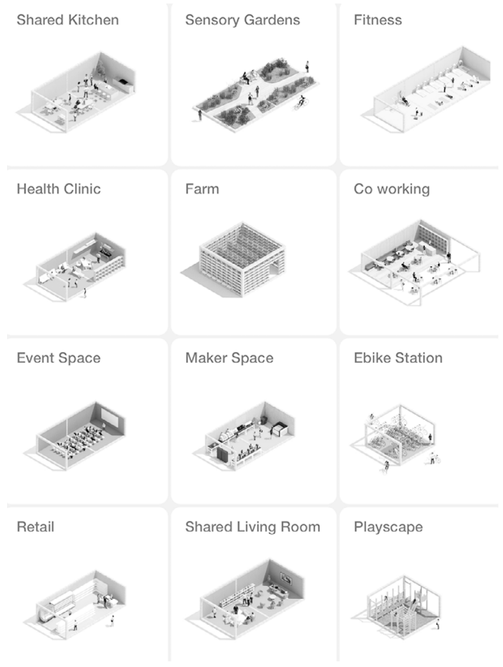
key features

<u>liveability - shared facilities and services</u>

As one of the three key values of this project, liveability is defined, by the architects, as environment that "suits our unique needs, needs to adapt to the pulse of daily life and offer us the support systems and social life we seek". It is achieved in the Urban Village Project by the following. 1) Exploring the possible benefits of living in a closely connected community, where a sense of belonging is cultivated by a variety of shared spaces that facilitate different activates (Figure 4.1.2), which include communal dinners, shared daycare, urban gardening, gym, groceries, and shared transportation (SPACE10, n.d.). 2) Space that enables cross-generational shared living is envisioned to approach meaningful human relationships among the residents, and therefore boost both mental health and happiness (SPACE10, n.d.). (Figure 4.1.3) 3) Instead of one standard apartment size which is hard to fulfill the needs of different residents, this project targets at a member of user groups, including single people, couples, families, and groups of friends; and offers different apartment types with different sizes and floor plans. (Figure 4.1.4)

<u>sustainability - recyclable modular building system</u>

Sustainability is reflected in this project from design, life cycle of the built environment, and management (SPACE10, n.d.). This analysis focuses mainly on the first two aspects as they are also the key feature of the design proposal. The modular building system, no doubt as one the key feature of



↑ Figure 4.1.1
The Urban Village Project. A recyclable modular building system that retinks a new way of living together. Source: EFFEKT Architects

← Figure 4.1.2
Shared spaces formed by different units' combination, which facilitate different activates. Source: EFFEKT Architects

the project, is replaceable, reusable, and recyclable over the lifespan of the building (SPACE10, n.d.), meaning it is possible to modify or adding modules to existing building structures, which are constructed by this modular building system (Figure 4.1.5) ; and in situations where building structures need to be disassembled, the module units and structures and be transported and reassembled in different configurations on the new location, and therefore achieve sustainability, by reuse and minimize waste. Building material wise, the system uses predominately CLT (cross-laminated timber) (SPACE10, n.d.), an environment friendly built material that gets more and more attention in recent years.

takeaways

To sum up, the Urban Village Project provides a vision of sustainable shared community living, where modular building system is used to provide maximum flexibility, in terms of reconfigurations according to different users' needs and building sites. And the idea of combining private living with shares space in a fine-grind pattern increases the chance of social interaction while cultivating a sense of connectedness. However, how to make shared space shareable and sociable even in pandemic times when group activities are restricted and physical connections are restricted, is the question I explore in the design proposal.

4.2 VERTICAL SHARED HOUSE

Project: LT Josai Shared House, 2013 | Nagoya. jp
Architects: Naruse Inokuma Architects
Project scale: M. (307m2)

project overview

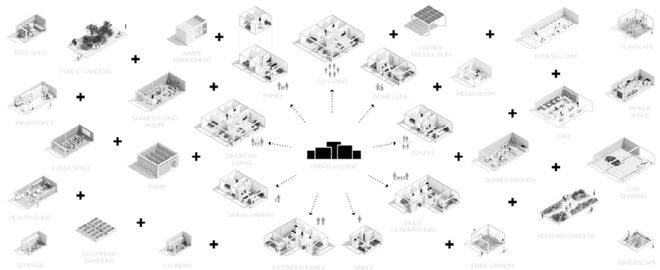
Designed by Naruse Inokuma Architects and built in year 2013, shared living is the key concept in this project. (Figure 4.2.1) Ways to create and manage public shared spaces within an individual building that were resided by different individuals were explored in this example. By taking a closer examination of their approach to achieve this goal, lessons can be learned for Shared Space Type 2: public space shared by specific households but private to the others, in the design proposal. Therefore, it is selected as one of the international examples, and the following presents the shared space creation and management in this project.

why this project

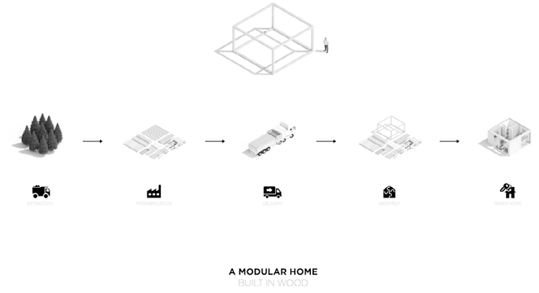
key features

<u>one connected shared space</u>

As an increasingly popular style of living in Japan (LT Josai Shared House, 2014), the concept of Shared house is nothing new, where a group of unrelated residents living together in a singular building each with its own



↑ Figure 4.1.3
Community social hub. Meaningful social interactions the benefit mental health, increase happiness. Source: EFFEKT Architects.



↖ Figure 4.1.4
Different apartment types with different sizes and floor plans that fit the needs for different households. Source: EFFEKT Architects.

← Figure 4.1.5
Modular building system that is replaceable, reusable, and recyclable. Source: EFFEKT Architects.

private one-room apartment and common shared space, it is pretty much like student housing. The only difference is that the occupants of shared houses might be in different professions with different lifestyle, while the latter is occupied all by students with relatively similar lifestyles and routines. LT Josai Shared House is one example of this housing model, located in Japan, it shows one way of organizing private rooms and shared space that boost the sense of community. Hosting single room apartments for 13 individuals, all private rooms are located next to the facades and remains the center area as one connected shared common space, which creates a sense of connection and facilitates social interactions. (Figure 4.2.2) On the ground floor, adjacent to the building entrance, the 3-story height atrium enables visual connections to different events and activities happens within the community. (Figure 4.2.3) The dining space is designed for gatherings of multiple people; spaces by the windows are for alone times; and kitchen counter can be a place for communications between a small number of people. Such shared spaces are created as extensions of individual rooms. (Figure 4.2.3-4.2.6)

takeaways

One big connected common shared space which careful considerations of allocations of different spaces that suit different activities, is what features this project. The centered 3-floor height atrium is the main activity space which plays a key role in connecting the residents visually emotionally and spatially. Yet, such spatial solution becomes questionable under the pandemic time when social activities with large number of participants were restricted to minimize human contact. To hold the number of people in certain space under control, breaking the scale of shared space seems inevitable. However, how to still build a sense of social connection under such condition is what I explore in the next chapter.

4.3 COMMUNITY-ORIENTED HOUSING

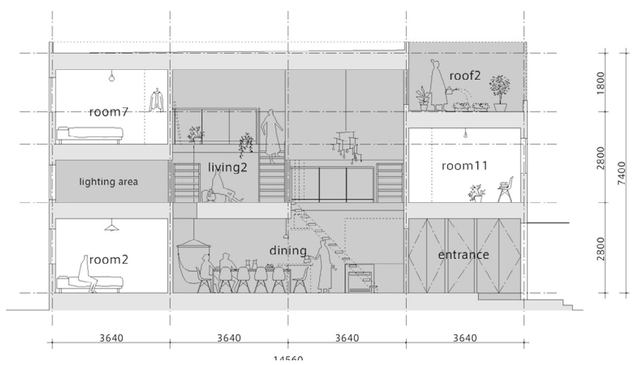
Project: Capitol Hill Urban Cohousing, 2016 | Seattle. us
Architects: Schemata Workshop
Project scale: M. nine households (1600+m2)

project overview

Built in year 2016, Capitol Hill Urban Cohousing was designed by Schemata Workshop (Figure 4.3.1). With a rooftop urban farm, it is a five-story mixed-use building developed by its residents, which approach gave an insight of what spaces and activities the residents desire and interested in as part of their community life. This project is, therefore, studied as one of the benchmarks of the public programs and spatial forms which can be a reference for the design solution in the next chapter.

why this project

a-a'section



↑ Figure 4.2.1
LT Josai Shared House. Public shared space, located in the center of the building, being the essence of the design. Source: Masao Nishikawa.

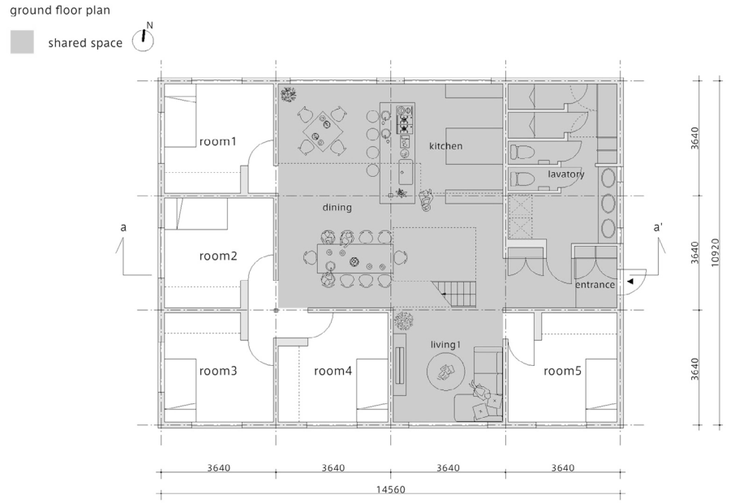
← Figure 4.2.2
With private rooms located next to the facades, the remained center area as one connected shared common space. Source: Naruse Inokuma Architects.

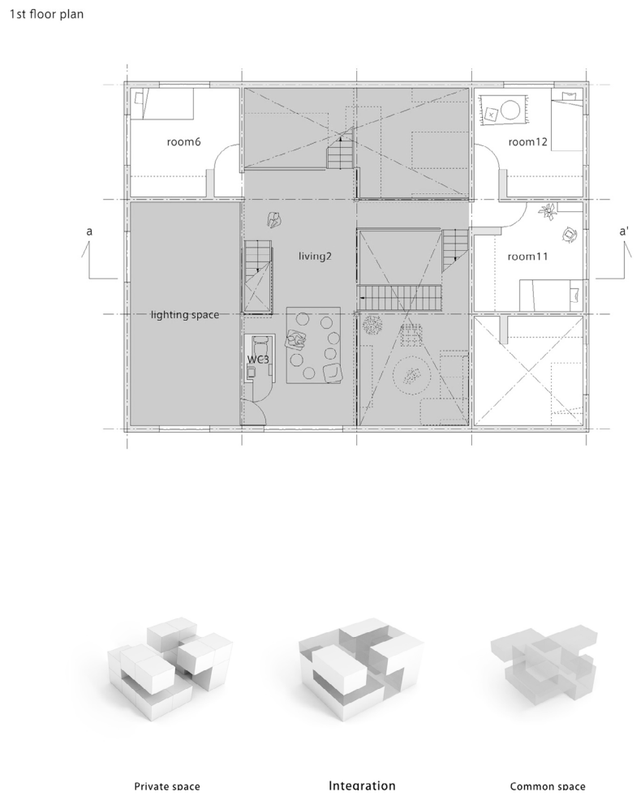
← Figure 4.2.3
The 3-story height atrium enables visual connections to different events happening within the community. Source: Masao Nishikawa.

↗ Figure 4.2.4
Ground floor plan. Spaces for different sizes of group and individual activities. Source: Naruse Inokuma Architects.

→ Figure 4.2.5
Shared spaces are created as extensions of individual rooms. Source: Naruse Inokuma Architects.

↘ Figure 4.2.6
Diagram from the Architects. Public-private space relationship. Source: Naruse Inokuma Architects.





key features

cohousing

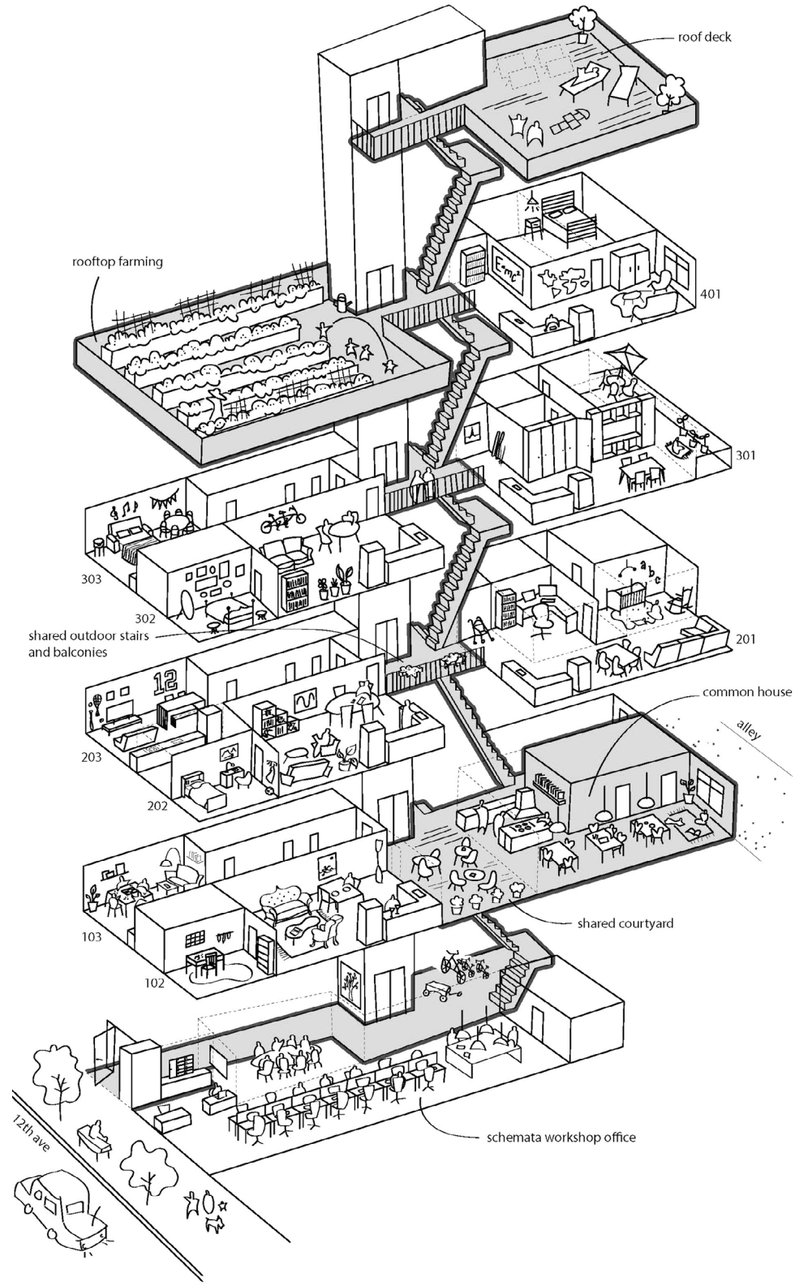
The key character of this project is its development model, known as Co-housing - originated in Denmark, it is "a concept by which a community of future residents embark on a real estate development venture, with priority given to building social cohesion among residents during the design and construction process", described by the architects (2016). Despite its physical appearance of a "typical, urban infill, mixed-used project" (schemata workshop, 2016), its design decision lead by such development process reflects what the future residents, as member of a knit-tight community, wish their life to be, and how they envision their future life will unfold (Figure 4.3.1). Even though the development model is explored in the Kaitaa Forest Village project, I found the spatial programs developed in CHUC fascinating, which analysis along with several other cohousing cases are as follow. (Figure 4.3.3 [comparison chart])

spatial programs

CHUC is a five-story building with its ground floor commercial space as the office space for Schemata Workshop, the upper four stories are homes to nine households. In addition to shared indoor space and roof garden, each unit comes with a kitchen, living space, and 2-3 bedrooms (schemata workshop, 2016). Similar to the previous project, this example shows what we desired in the pre-pandemic time. (Figure 4.3.1) A small courtyard locating at the center of the building, which opens visual connections to different occurring activities within the community and therefore create a sense of connection. A common house, which is essential to the community space, is located at the second floor of the building, adjacent to the center courtyard, where 30-people dinning events can be hosted. How to create space that facilitate social interaction among the residents, is the main challenge that the architects took on, which is also the question I ask myself throughout this thesis. Moreover, can we still have common shared space during pandemics? What kind of spaces would that be? I cannot help but imagine.

takeaways

What I learned from this project is a vision from a group of residents of what community life meant to them and their wishes of the activities that they would like to have, and the spatial solutions provided by the architects, according to the requests. Like a self-sufficient vertical community, its spatial programs showcase a possibility of working from 'home' but not being confined at home, in pandemic times. Coming down from upper apartment floors to work in the office which locates on the lower floor, such spatial arrangements minimize the commute that we try to avoid in pandemics and to provide to opportunities of working in office.



← Figure 4.3.1
Capitol Hill Urban Cohousing. A five-story mixed-use building developed by its residents. Source: Schemata Workshop.

4.4 RADICAL MODULAR FUTURE LIVING SYSTEM

Project: Urban Nest, 2017 | Shanghai. cn
Architects: Penda
Project scale: S. 3 × 3 × 26 (200m2)

project overview

Created by Penda Atchitects and built as a temporary exhibition piece in Urban Matter, Shanghai, 2017, Urban Nest is the latest example in MINI LIVING's series of low-personal-footprint concept dwellings (Narea, 2017), which constructed from singular-size modules with different program elements that enables different spatial configurations which supports a variety of flexible living arrangements (Shu, 2017). Closely in line with my design approach in the Kaitaa project, its modular system, configuration variants and the fusion of buildings with nature are the main aspects of interests and analyses of this referenced project. (Figure 4.4.1)

why this project

key features

<u>modular system</u>

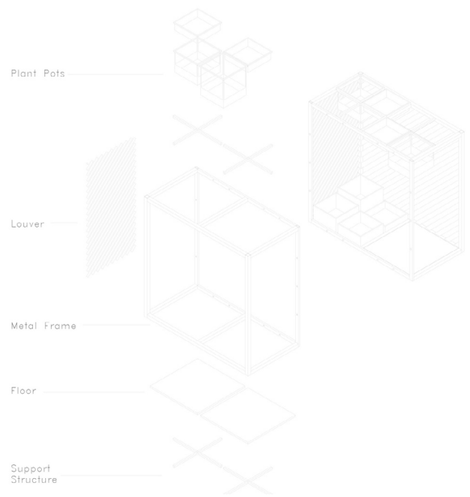
One of the most iconic features of this project is its prefabricated modular system which is formed by 3m × 3m × 3m cubic modules, which are constructed from recyclable metal (Shu, 2017). Composed by two pre-manufactured parts from factory - simple metal frames and slanted perforated louvres which can create different levels of privacy depend on the usages (Figure 4.4.2) - each module can be assigned with different functions and be combined with each other flexibly according to the changing needs of the occupants. Its modular nature also allows for reassembling of the modules and reconfiguring different spatial combinations.

<u>configuration variants</u>

As a temporary installation, Urban Nest is formed by 26 modules which functions include living room, kitchen, dining room, cafe, reading room, study room and bookstore, studio, workshop, and gym (Griffiths, 2017). Located at a narrow site which reminiscent old urban fabric in Shanghai, its configuration of the 26 modules aims to showcase future living concepts can be created in the context of existing urban fabrics, but flexible enough to fit different living arrangements and adapt to emerging future scenarios (Griffiths, 2017).

<u>blend in with nature</u>

Another highlight of this project is the concept of blending the building and nature, softening the physical facades, using green as a part of the boundary itself. It is of a great value to test such design approaches in pandemic



↑ Figure 4.4.1
Urban Nest Project. A radical modular future living system. Source: Penda Architects.

← Figure 4.4.2
Prefabricated modular system. Metal frames and slanted perforated louvres that enables different levels of privacy. Source: Penda Architects.

times as we reply more and more on nature and greenery to break away from quarantines and self-confinements. And therefore offeres resilience of maintaining residences' well-being under extraordinary circumstances, such as this pandemic (Samulesson et al, 2020). In this project, as Figure 4.4.3 shows, instead of artificial materials plants are used to separate inside and outside space. Also, by introducing greenery into interior spaces (Figure 4.4.4), connections are made between buildings and nature.

takeaways

Among the features analyzed above, the two levels of flexibility shown in this example: the possibility of modifying and expanding the building mass with the change of time; the ability of holding different activities in certain unchanged spaces, enables resiliency of spaces. A key spatial character that is needed in the Kaitaa project, where I explore a resilient spatial solution which enables shared community living under pandemic times. The introducing greenery into the interior, on the other hand, can be taken as a design language that help with the residents' mental wellbeing and as soft separations that could replace plastic or verbal signs for physical distancing.

4.5 CONCLUSIONS

shared spaces in different scales

With a shared value of creating a tightly connected community living at heart, the international examples analyzed in this chapter present solutions and references of creating common shared spaces in variety of scales: from common spaces shared by certain households to public spaces for the whole neighborhood.

more spaces, smaller spaces

When it comes to the allocation of indoor shared public spaces, one can notice that in both Capitol Hill Urban Cohousing and LT Josai Shared House project it is designed as one-big-connected space which located in the center of the buildings, connecting spaces as well as visuals from different floors. However, as we all experienced, such spaces are no longer functioning as well as it were before the COVID-19 pandemic. On the contrary, what it once was the center of the community, as those centered shared atriums, became the most restricted spaces during the pandemic. In other words, instead of large inside public space that allows large gatherings, shared space that is designed for a small group of people are what we urgently need. It is not to say that large public space shall not exist during pandemics. Unlike indoor spaces where ventilation is limited, outdoor

← Figure 4.4.3
Using plants to define inside and outside spaces. Source: Penda Architects.

↑ Figure 4.4.4
Greenery as a bridge to conntect interior and the nature. Source: Penda Architects.

public spaces where the transmission rate of air born viruses such as COVID-19 is considerably lower then the former, large public space has the advantage of keeping the density low and therefore allows for better safety.

modularity

The Urban Village Project and the Urban Nest project provide us radical visions for future urban livings. Despite their stay on the theoretical level, I found their exploration of modular system as one of the solutions to the urban issues fascinating. And as one of my focus of the Kaitaa proposal, their studies of the modular systems and its advantages give bases for the system I am proposing later in the next chapter.

greenery: a new interior separation

Another aspect that is especially important for pandemic resilient neighborhood is the mental wellbeing of residents. In all four examples, different usages of green and plants are explored, from roof-top garden to using greenery as building boundaries, all can be used as references for the Kaitaa project. In addition, using greens as soft interior 'partitions' is what didn't appear in the example projects but can be a great usage in pandemic resilient neighborhood design.

Chapter 5

Design proposal

Taking the learnings of the four international examples from the previous chapter, this final chapter presents a design proposal of a modular pandemic resilient neighbourhood. The design proposal is made of two parts: first, a modular system, with three levels of flexibility; second, site application, where the system being tested on a real site locates in Kaitaa, Espoo. The design brief is made, by the author, based on the learnings and findings from site analysis in Chapter 3. Different programme configurations for various scenarios are presented through isometric diagrams, as a showcase of the flexibility for the modular system to adapt to different needs and times.

5.1 MODULAR BUILDING SYSTEM

Typical wood structural systems are Load-bearing walls system, Pole-framed element system, Column-and-beam system, and Volumetric elements system (Puuinfo, 2020). Each system has its own merits that suit for different spatial functions and building types. In this project, a mix of structure systems are used in achieving the goals of construction efficiency, flexibility in change of floor plans throughout the time.

primary structure system

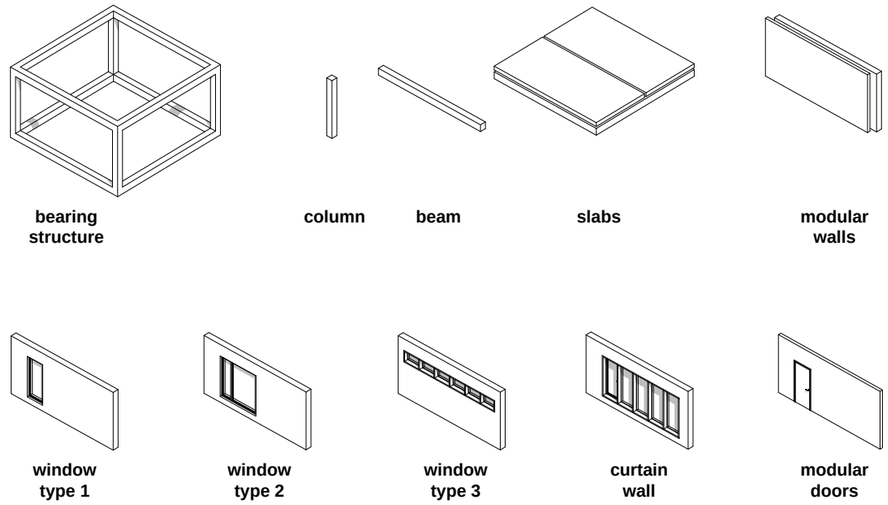
column-and-beam structure

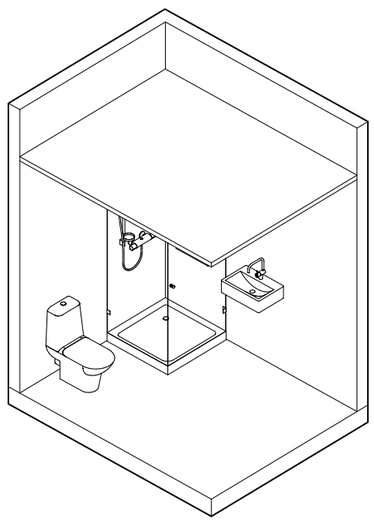
To enable maximum flexibility of the floor plans, such as adding and dismantling walls in and between apartments, as the needs for occupants will change during life cycle of the buildings, column-and-beam structure is used as the main construction system in this design proposal. The beams and columns assembled on site are functioned as bearing structures for interior spaces such apartments, public services and commercial spaces, and for those 'empty' spaces, in certain phase of the building's life cycle, with only beams and columns around but no closing walls, the existed structure provides possibilities to turn those areas into indoor space for different usages when situation calls. For example, adding walls and slab to an adjacent 'empty' space as an expansion to an existed apartment. See Figure 5.1.1.

supplementary structure system

volumetric elements system

Commonly used in wooden apartment blocks building in Sweden, Volumetric elements system is 'a construction method in which a building is assembled separately in a factory from ready-to-assemble box units… that usually consists of a load-bearing frame and limiting surfaces', which makes each volume unit structurally independent from others. Because of the double structure from adjacent units, it has better sound insulation compared to the other structure systems with the same wall thickness. This structure system also allows for complete manufacturing of ready walls, floors, and have windows, HVAC, electrical equipment installed in the factory. With only assembling left to do on-site, it makes very fast on-site constructions and, therefore, a perfect choice in infill developments and projects that require minimum disturbance to the neighbouring areas (Puuinfo, 2020). It is used as a supplementary structure system in this design proposal specifically for bathrooms, also labelled as wc in architectural drawings and diagrams that are presented later in this chapter, as all bathrooms in this modular system are confined into two sizes only: one for accessible toilet and the other in small size which is inaccessible. See Figure 5.1.2.





↑ Figure 5.1.1
Primary structure system: Column-and-beam structure, and basic modular building elements.

← Figure 5.1.2
supplementary structure system: volumetric elements system.
1:70

5.2 FLEXIBILITY LEVEL I
FLEXIBLE HOMES

Flexibility is used as a main approach in this design proposal to achieve resiliency in facing future pandemics - unexpected challenges that could completely shift our life to unknown directions, like the COVID-19 pandemic we are still battling with. Yet, it is predicted that such scenarios will happen more frequent in the future (Marani et al., 2021).

same time, different spaces

Can we prepare our living environment - buildings, landscape and community - for such future crises? I would like to believe the answer is yes. The question is only how. As the crises are unknown and unpredicted of the time, the place and forms of their happening, it is, for architects, the challenge of creating spaces that work for different needs in different scenarios when facing different future challenges. How to create space that could transform from one form to another and even many others, the idea 'pixel' comes to my mind - all the pixel images are in different shapes are appearances, but they are all formed by the same pixel units with just different formations and different colours, and yet the results are completely different.

A mechanism sounds perfectly suit for the challenge, creating basic unit in one dimension, as in pixel; and multiply and designated them in different functions, as in pixels in different colours; then, form them in different configurations to create different types of building environments for different needs. In this first level, in turns of scale - the smallest one, of flexibility: different types of apartments in the same grid size are designed for different user group with different lifestyles and daily needs. Six basic apartment types with over fifteen variations. Figure 5.2.0-5.2.6. Only in this case, the function for units could change throughout the time according to different scenarios and users' needs, which will be elevated in part 5.3.

One person studio for students and people who lives alone.

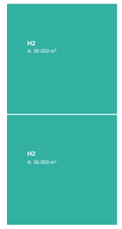
H1 36m²

entrance
wc
kitchen
living/dining area
sleeping area
flexible space

Figure 5.2.1
Apartment type H1.
1:300

apartment types
| H2

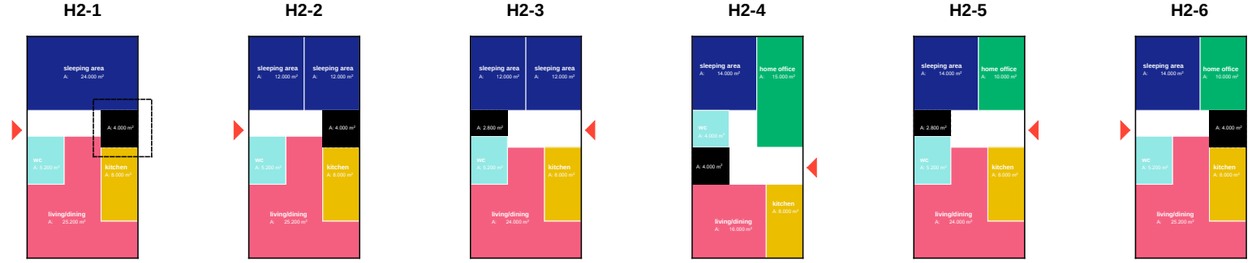
Two-people studio, for friends like Joey and Chandler or later couples like Chandler and Monica, with 6 possible layouts from 1 king size bedroom to 2 regular size bedrooms to 1 regular size bedroom and 1 home office. Each layout has with a 4m2 flexible space, facing the apartment front door with big windows, which usage can be decided by the users, whether to use it as a storage room, extra wc or room entrance, or just leave it as a spacious entrance.



H2 72m²

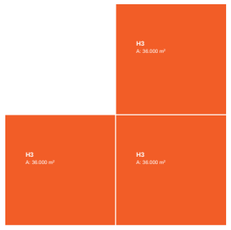
- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office

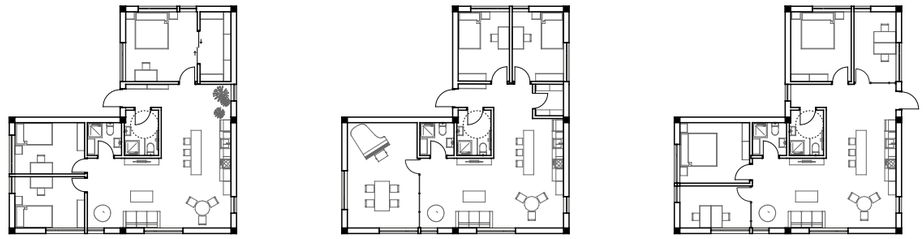
Figure 5.2.2
Apartment type H2.
1:300



Family size apartment, able to have 1 king size bedroom with 1 spacious home office to 2 bedrooms each with an office space to maximum 4 bedrooms, could be for couples like Monica and Chandler and sometimes stay-over visit from their friend Joey. Each layout has 2 toilets one of which is accessible and a 4m² flexible space, facing the apartment front door with big windows, which usage can be decided by the users, whether to use it as a storage room, extra wc or just leave it as a spacious entrance.

H3 108m²





- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office

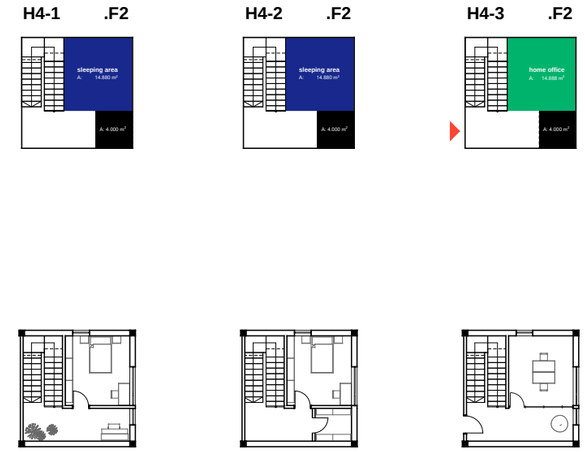
Figure 5.2.3
Apartment type H3.
1:300

apartment types
| H4

Two-story family size apartment, with possibilities to locate the front door on either 1st or 2nd floor. The apartment type can have 1 bedroom with 1 home office to 2 bedrooms, suitable for couples like Monica and Chandler and their future babies. Each layout has 1 accessible toilet and a 4m² flexible space on each floor, facing the apartment front door with big windows, which usage can be decided by the users, whether to use it as a storage room, extra wc or just leave it as a spacious entrance.

H4 108m²

- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office



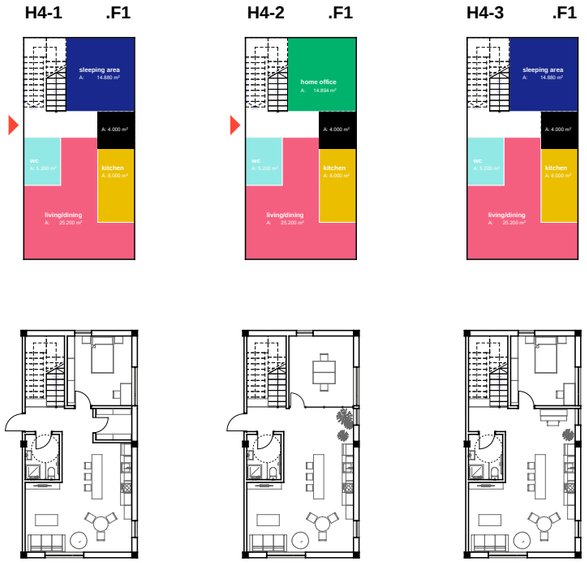


Figure 5.2.4
Apartment type H4.
1:300

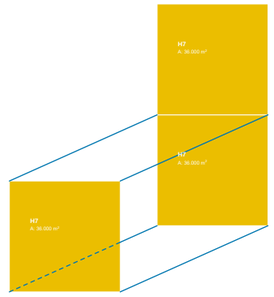
Two-story family size apartment, with possibilities to locate the front door on either 1st or 2nd floor. The apartment type can have 1 bedroom located on the 2nd floor and commercial space on the 1st first floor, see H5-3, to 2 bedrooms with home office to each, see H5-2, to maximum 3 bedrooms and 1 home office room, see H5-1. Suitable for couples like Monica and Chandler, their future babies and Joey when he's old. Each apartment layout has 2 accessible toilet and a 4m² flexible space on each floor, facing the apartment front door with big windows, which usage can be decided by the users, whether to use it as a storage room, extra wc or just leave it as a spacious entrance.

H5 144m²

- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office
- store/home business

Figure 5.2.5
Apartment type H5.
1:300

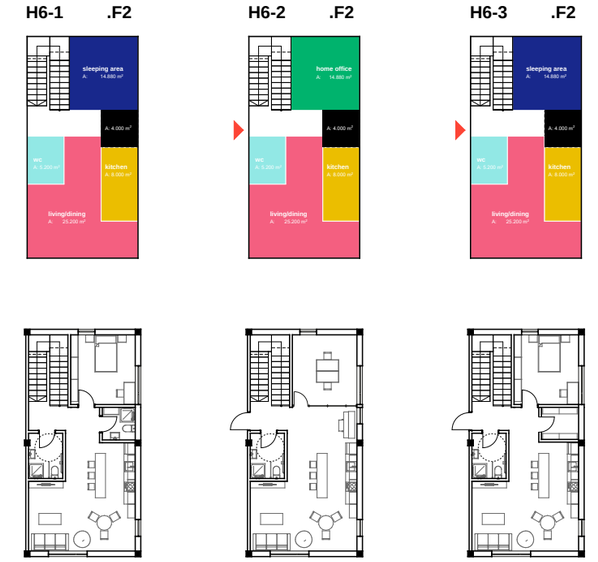
Two-story family size apartment, with possibilities to locate the front door on either 1st or 2nd floor. The apartment type can have 1 bedroom apartment located on the 2nd floor and commercial space on the 1st first floor, see H6-3, to 1 bedroom and 1 home office, see H6-2/H6-1, to maximum 2 bedrooms, one on each floor. Suitable for couples like Monica and Chandler and their future babies. Each layout has 1 accessible toilet and a 4m² flexible space on each floor, facing the apartment front door with big windows, which usage can be decided by the users, whether to use it as a storage room, extra wc or just leave it as a spacious entrance.



H6 108m²

- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office
- store/home business

Figure 5.2.6
Apartment type H6.
1:300



5.3 FLEXIBILITY LEVEL II
FLEXIBLE BLOCKS

same space, different times

In the scale of housing blocks, the same as the apartment layouts, to achieve the maximum flexibility, elements and room programmes are considered in the level of fix-ness. The most fixed elements: columns and beams, are functioning as bearing structures for the current indoor spaces and also for the potential future indoor spaces that are currently as exterior spaces.

Next to the bearing structures, stairs and bathrooms are considered the most fixed room programmes among them all, therefore, they were considered the first when it comes to housing blocks' floor plan. To achieve the maximum flexibility - in terms of enable changes from one apartment type to another for one space throughout the time - bathrooms are put in the centre of housing blocks so that it fits for all six apartment types - H1 to H6.

Kitchen are the considered next after the bathrooms, in all apartment type layouts, kitchens are located on the facades, so when a certain space change from one apartment type to another, the apartment layout could stay the same as much as possible, and therefore, realize the flexibility within each apartment.

Spatial flexibility among apartments, in each housing blocks, is achieved by combining extra adjacent units or cut off its own units to form different indoor spaces, according to different users' needs, for examples, apartment type H1 could be expanded into apartment type H2-H6, see Figure 5.3.2-5-3-7. Together with the spatial flexibility comes the flexibility in in function and spatial usages. For example, a two floors apartment could be transformed into an upper floor flat and a ground floor small business store; a 72m² two bedroom apartment could be expanded into a 108m² apartment with a proper home office apartment, by combining the neighbouring spared basic unit. It is in the housing block scale showcases the second level of flexibility and it is called as the subtitle suggests *flexible blocks*.

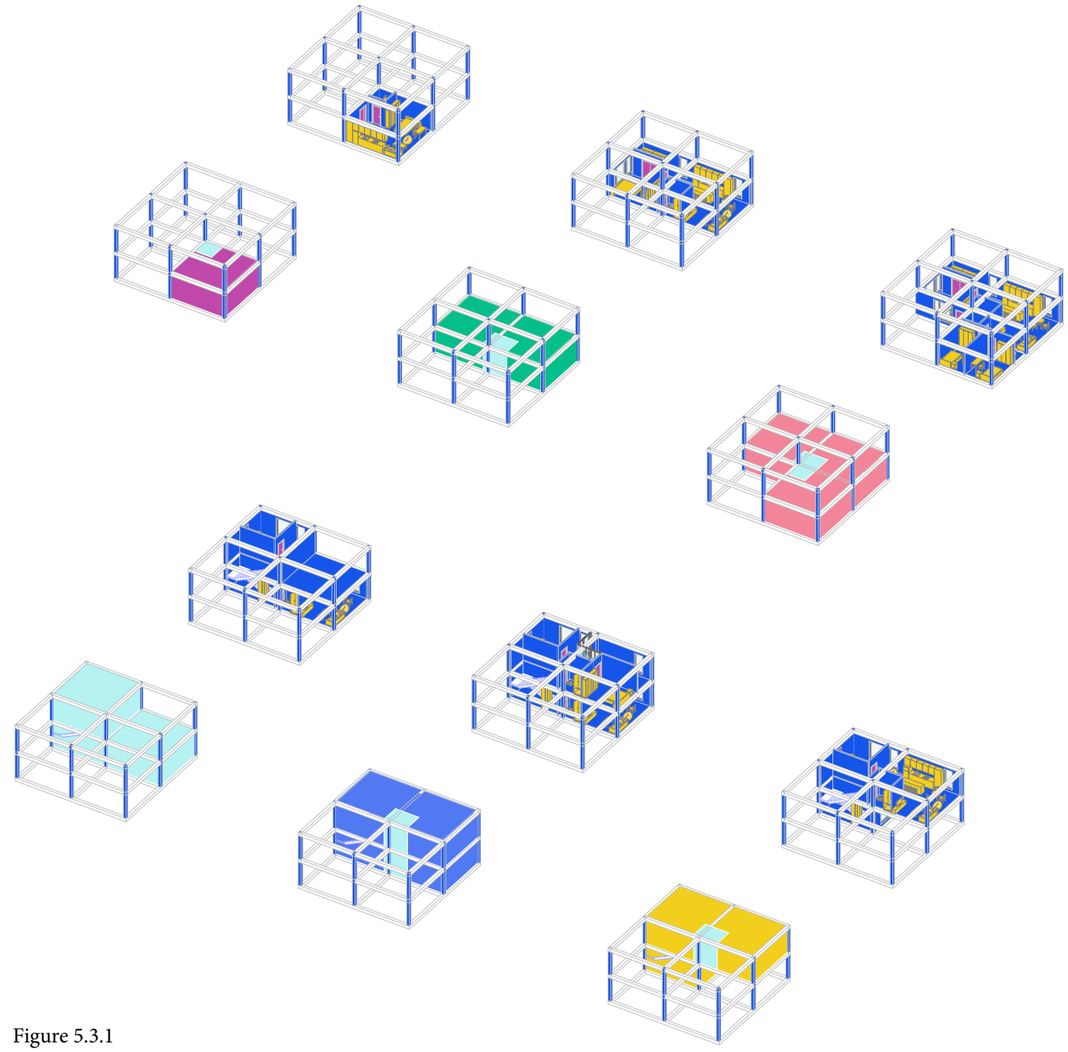
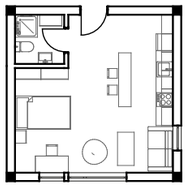
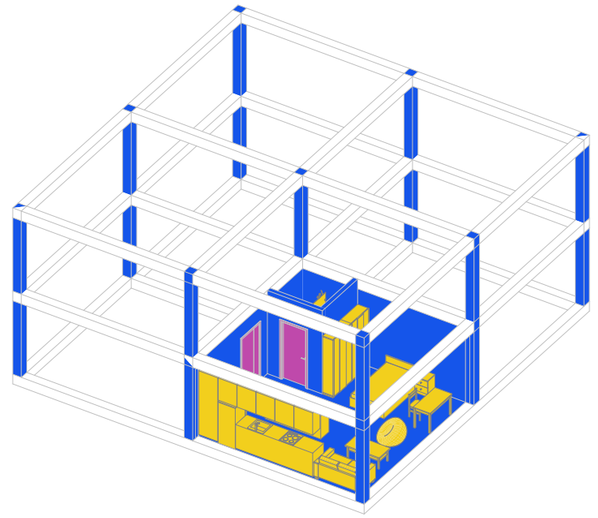
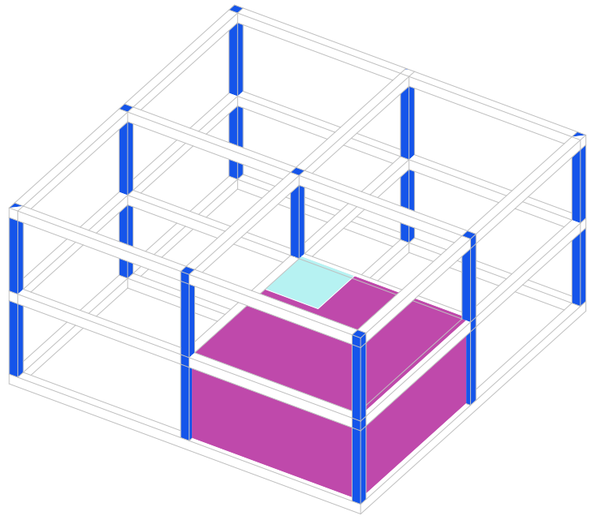


Figure 5.3.1
Isometric view
Apartment types overview



H1 36m² → H2 72m²

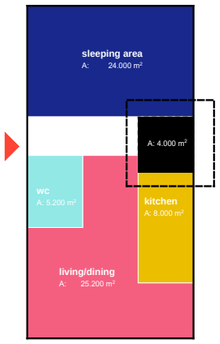


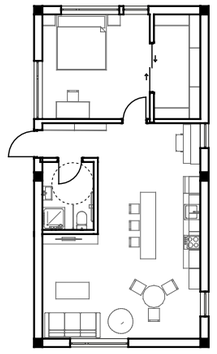


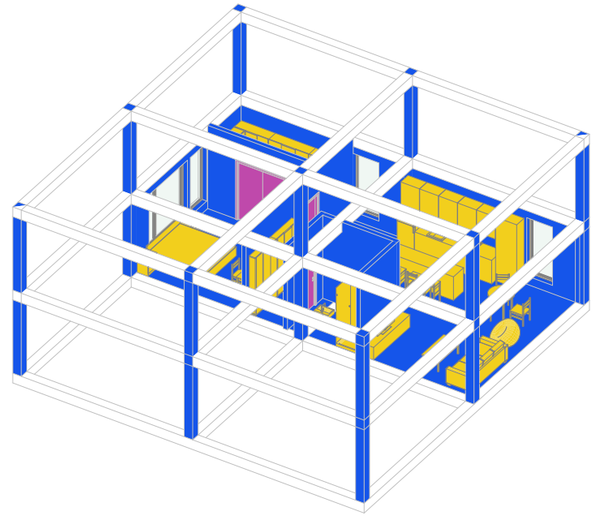
- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space

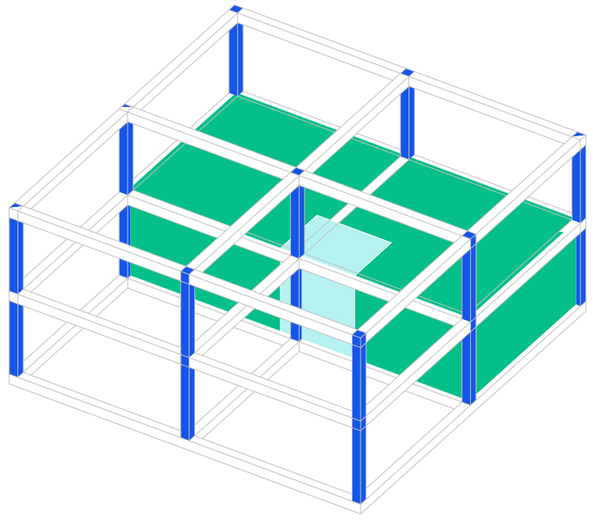
- wc
- H1

Figure 5.3.2
Isometric view of apartment type H1.
1:200







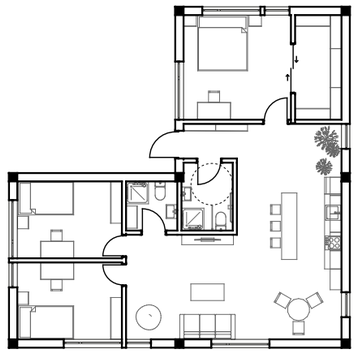


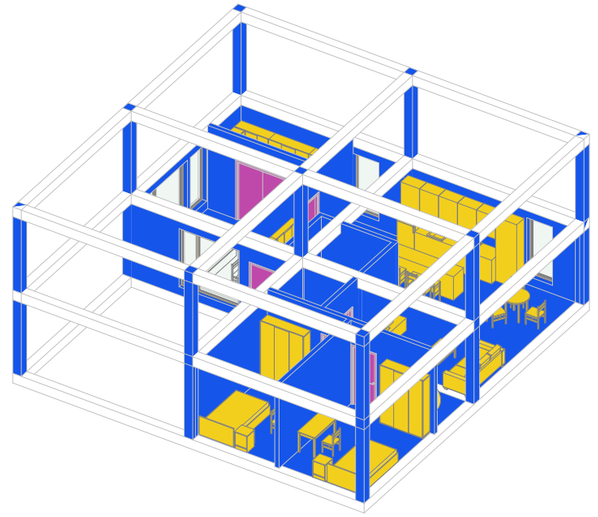
H2 72m² → H3 108m²

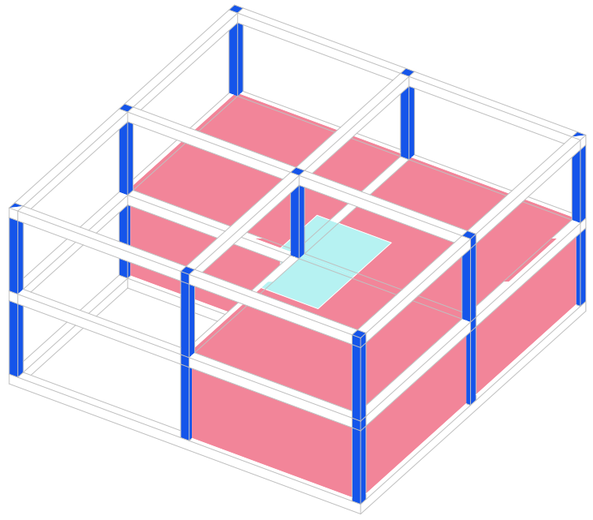
- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office

- wc
- H2

Figure 5.3.3
Isometric view.
From apartment type H1 to H2.
1:200





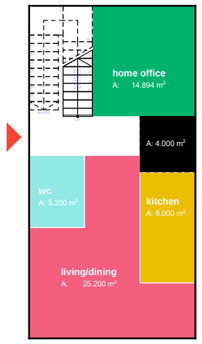


H3 108m² → H4 108m²

entrance
wc
kitchen
living/dining area
sleeping area
flexible space
home office

wc
H3

Figure 5.3.4
Isometric view.
From apartment type H2 to H3.
1:200



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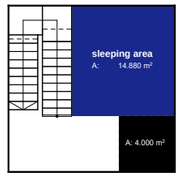

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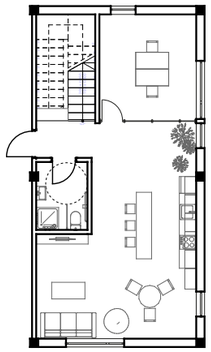
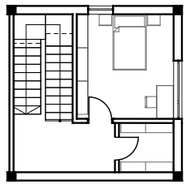
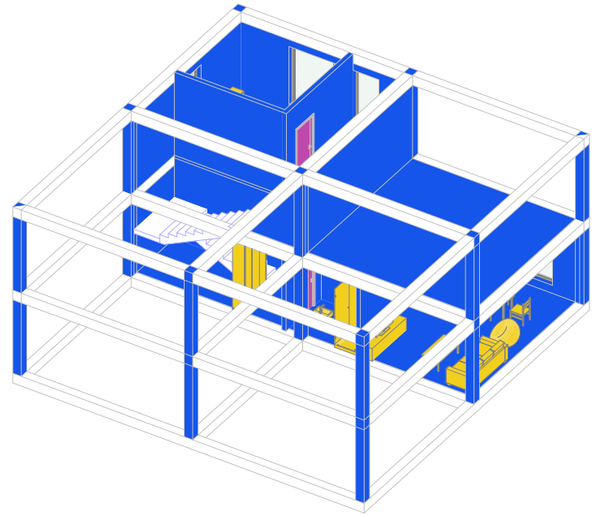
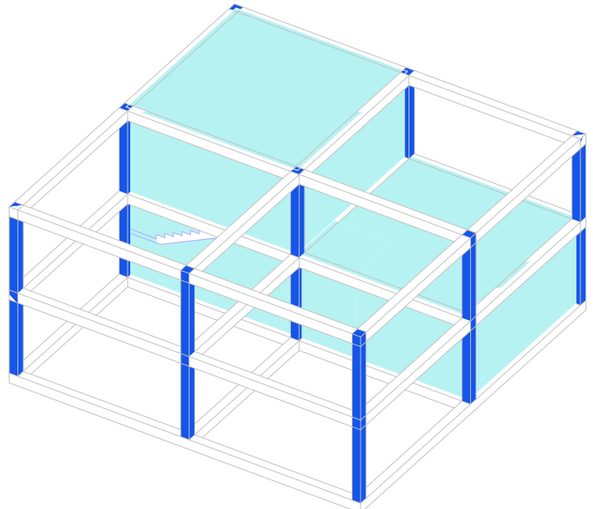






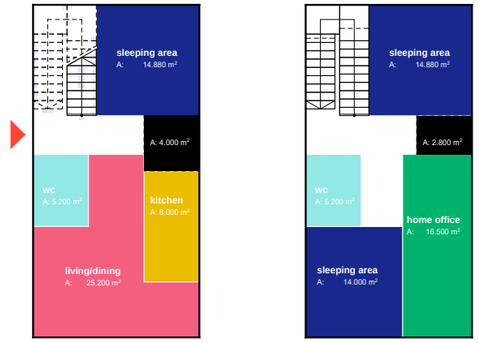


H4 108m² → H5 144m²

- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office

- wc
- H4

Figure 5.3.5
Isometric view.
From apartment type H3 to H4.
1:200



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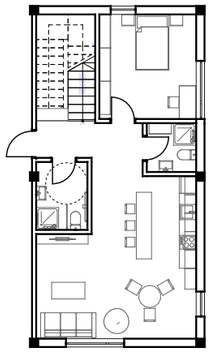
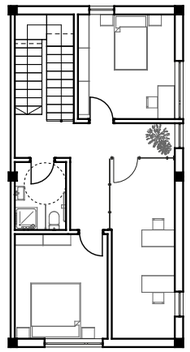
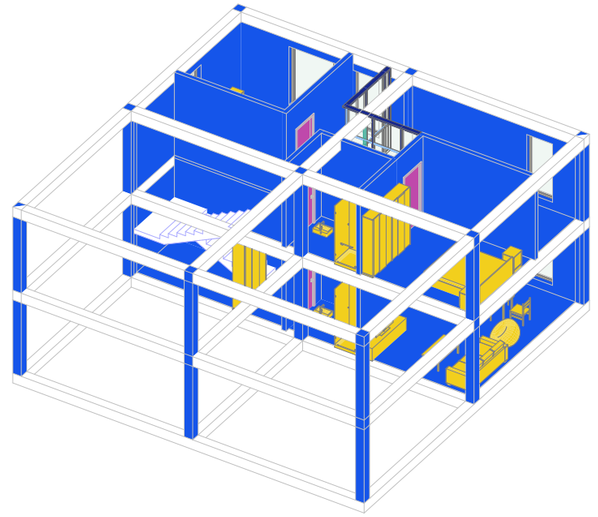
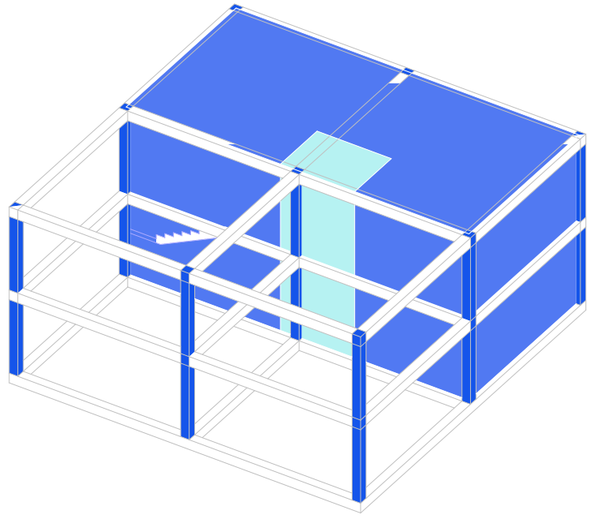






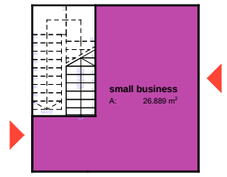


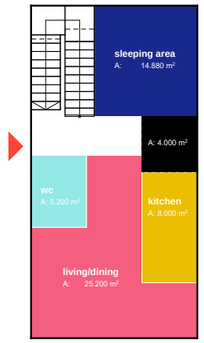
H5 144m² → H6 108m²

- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office

- wc
- H5

Figure 5.3.6
Isometric view.
From apartment type H4 to H5.
1:200





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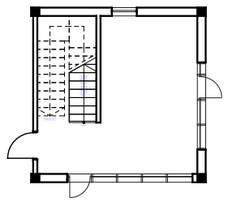
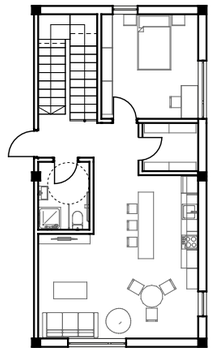
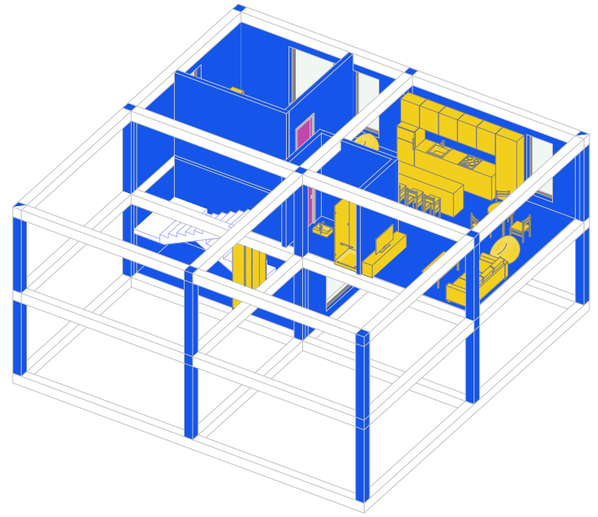
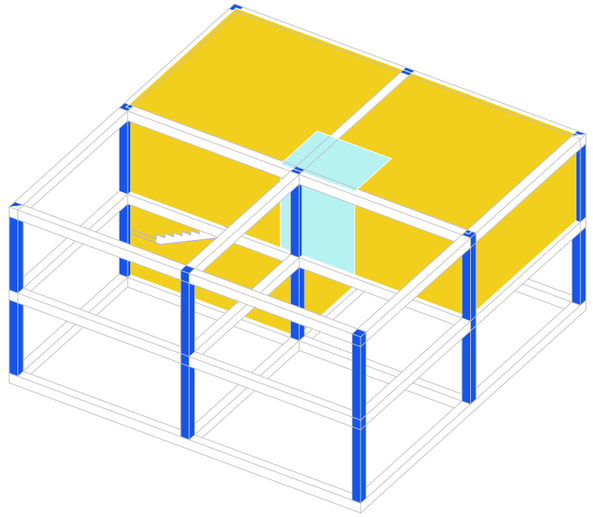








H6 108m² → X

- entrance
- wc
- kitchen
- living/dining area
- sleeping area
- flexible space
- home office
- store/home business

- wc
- H6

Figure 5.3.7
Isometric view.
From apartment type H5 to H6.
1:200

BLOCK 1

BLOCK 2

BLOCK 3

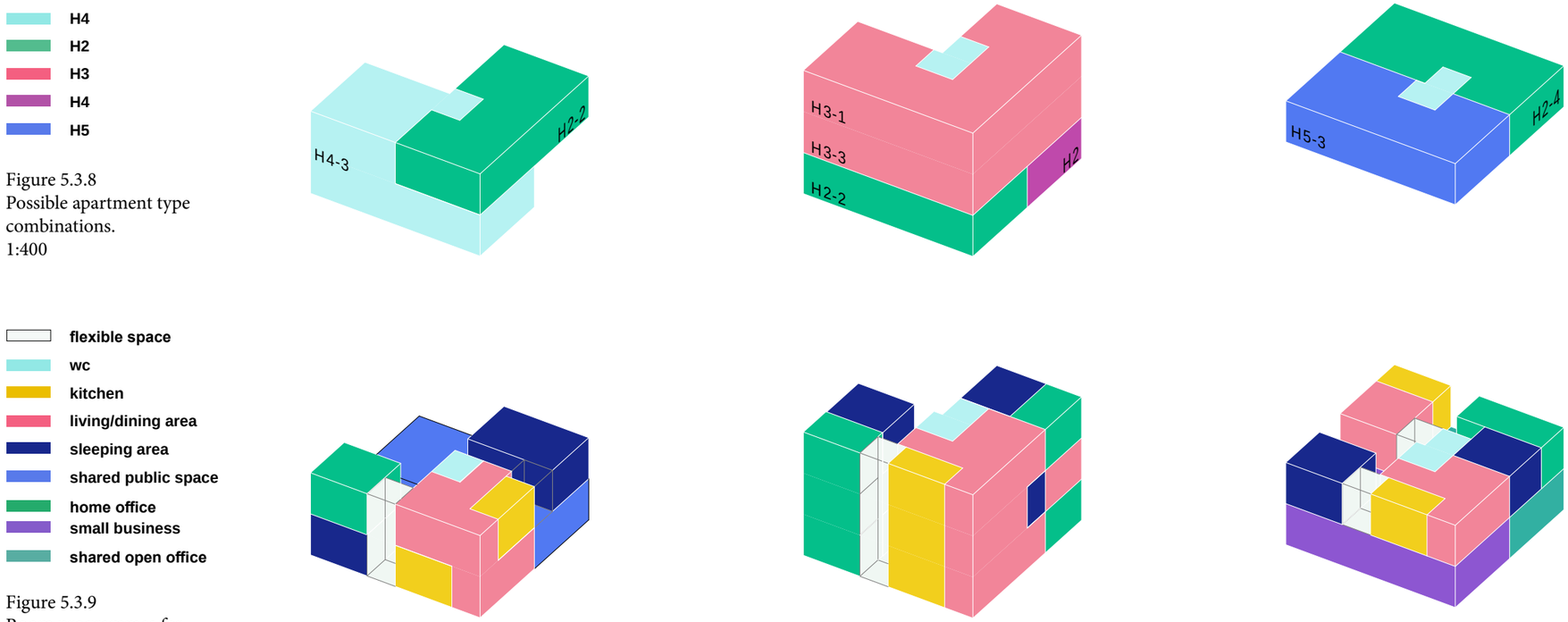


Figure 5.3.8
Possible apartment type combinations.
1:400

Figure 5.3.9
Room programmes for each combination.
1:400

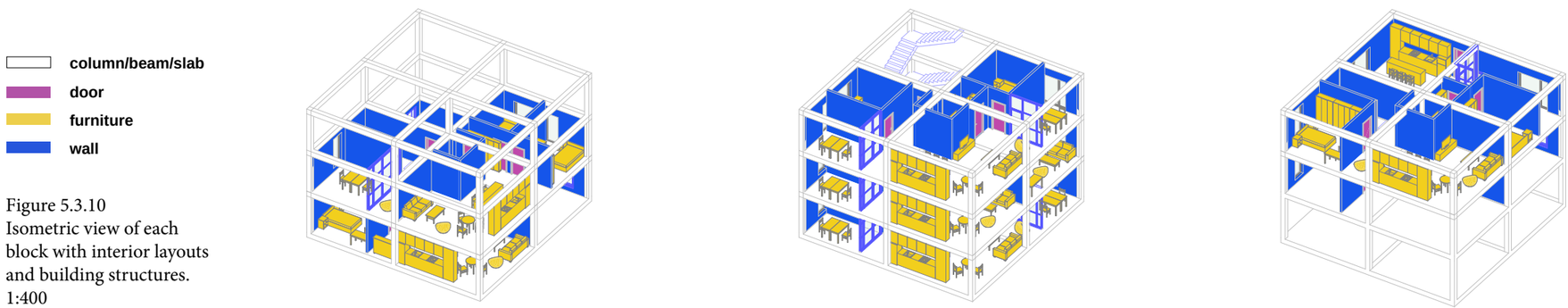


Figure 5.3.10
Isometric view of each block with interior layouts and building structures.
1:400

BLOCK 4

BLOCK 5

BLOCK 6

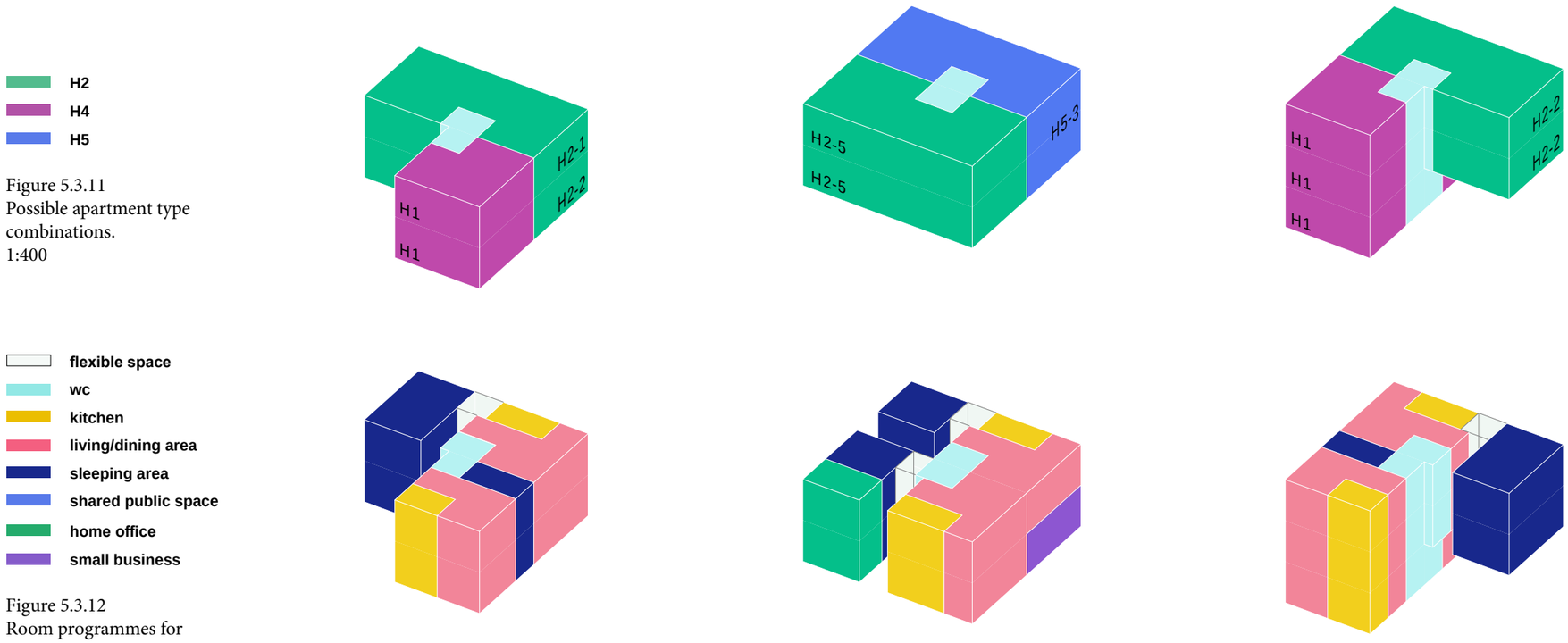


Figure 5.3.11
Possible apartment type combinations.
1:400

Figure 5.3.12
Room programmes for each combination.
1:400

Figure 5.3.13
Isometric view of each block with interior layouts and building structures.
1:400

BLOCK 7

BLOCK 8

BLOCK 9

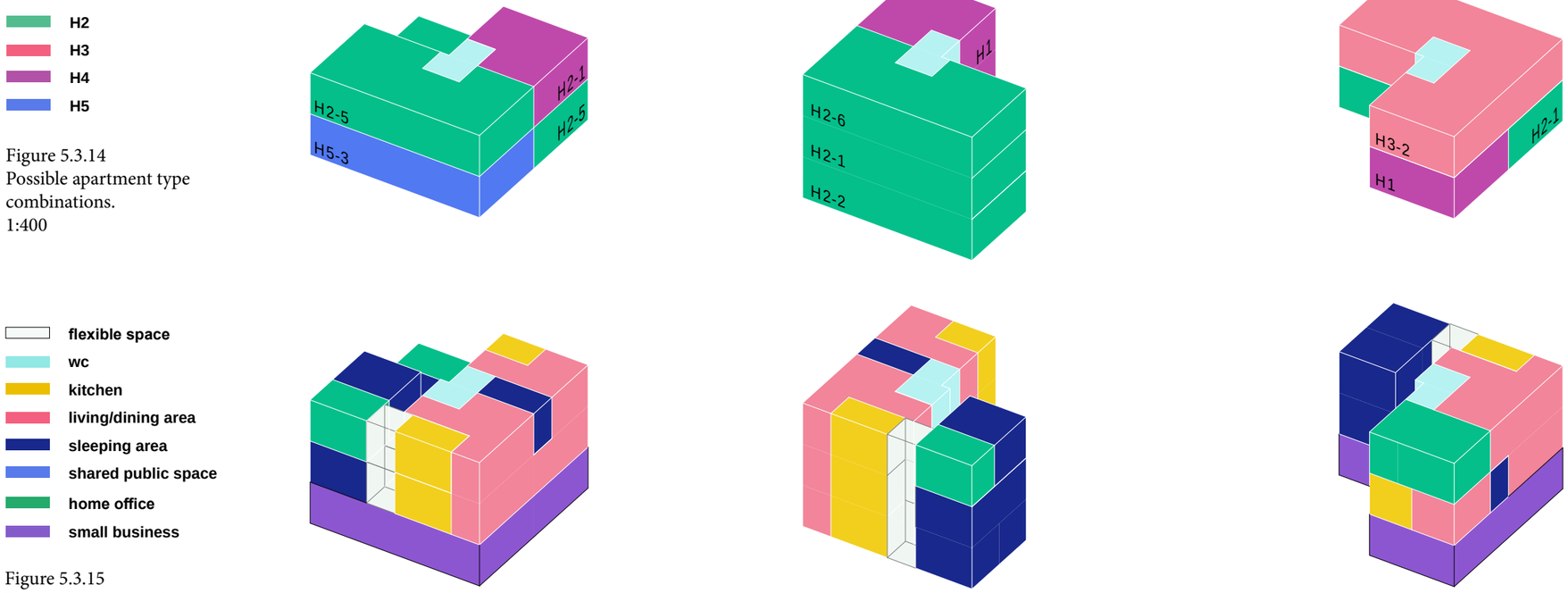


Figure 5.3.14
Possible apartment type combinations.
1:400

Figure 5.3.15
Room programmes for each combination.
1:400

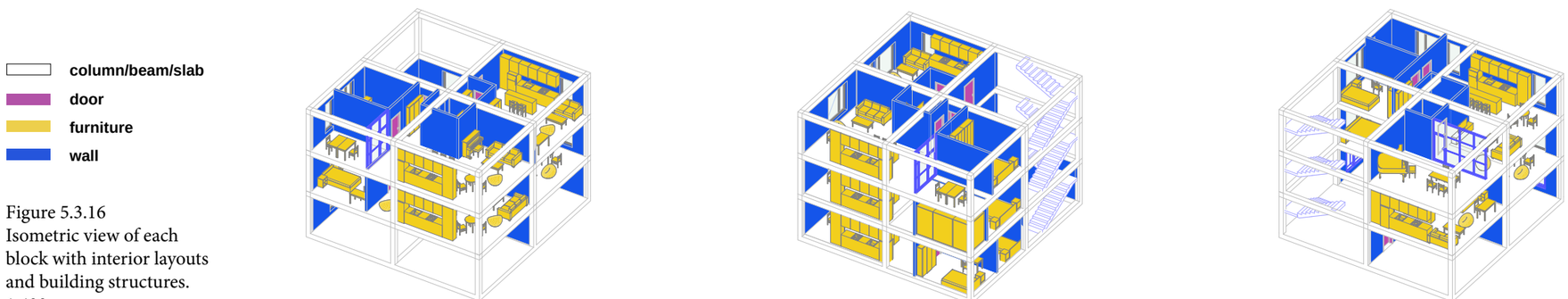


Figure 5.3.16
Isometric view of each block with interior layouts and building structures.
1:400

5.4 FLEXIBILITY LEVEL III
SITE APPLICATION

To test the modular system, and to explore its flexibility and adaptability to different scenarios - normal and pandemic times - in neighbourhood scale, the modular system is applied in a pandemic resilient neighbourhood design on a chosen site which locates in Kaitaa, Espoo.

Taking the results from the site analysis in chapter three, the neighbourhood is to be designed into a mixed-used residential area with new housing types - compose by the 6 apartment types and 19 variants that are introduced in 5.2 and 5.3. Local public services, including community clinic, shared open office, study room for small groups, dancing studios, multi-facility hall, roof gardens and urban farm market, are included in the room programmes to fulfil the daily needs of its residents. Flexible indoor spaces, located mostly on the ground floor, should be designed, which can be used either as retail space for small local business in pandemic times or as apartments in normal time. Among those spaces for commercial usages, spaces for small local business are put into the priority in terms of spatial distribution and arrangement, as shown in the site analysis, neither existed buildings in the area nor in city's future planning were such specific usage been taken into much consideration.

In this part, the evolution process of the site is presented with separate isometric views of building structures and different spatial elements in the reverse order of flexibility - from bearing structure as the very fixed element to staircase as the vertical circulation to wc and kitchens and to the rest of the spatial programmes such as bedroom, living room, indoor service space and space for local business, which at the same time reveal their spatial relationship with each other. Followed by isometric views of three different programmes configurations adapted to three different possible scenarios - normal times: high demand in housing (scenario 3), pandemic times: high demand for separated small indoor shared space for activities in small groups (scenario 2), the ideal times: services area and space for small local business take up the highest percentage of the total floor area compare to the other scenarios, with certain public spaces are open to not only residents living in this neighbourhood but also in surrounding areas (scenario 1). And next, scenario 1 is taken as an example, presented which floor plans, sections, elevations, and visualisations. Finally, the chapter, so does this thesis, is ended with conclusions of the main design approach and the aspects that require future studies.

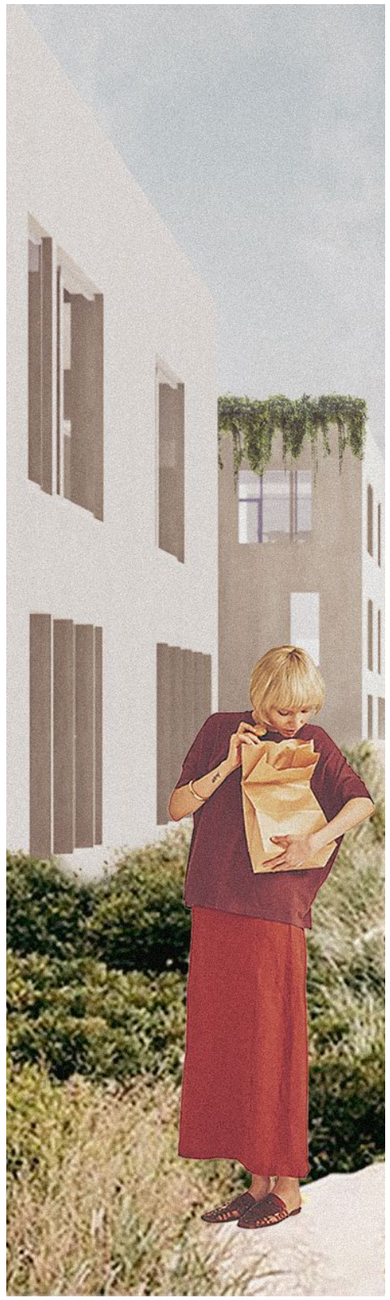


Figure 5.4.0
Street view
A woman come back from a bakery opens in this neighbourhood.

site model
| before

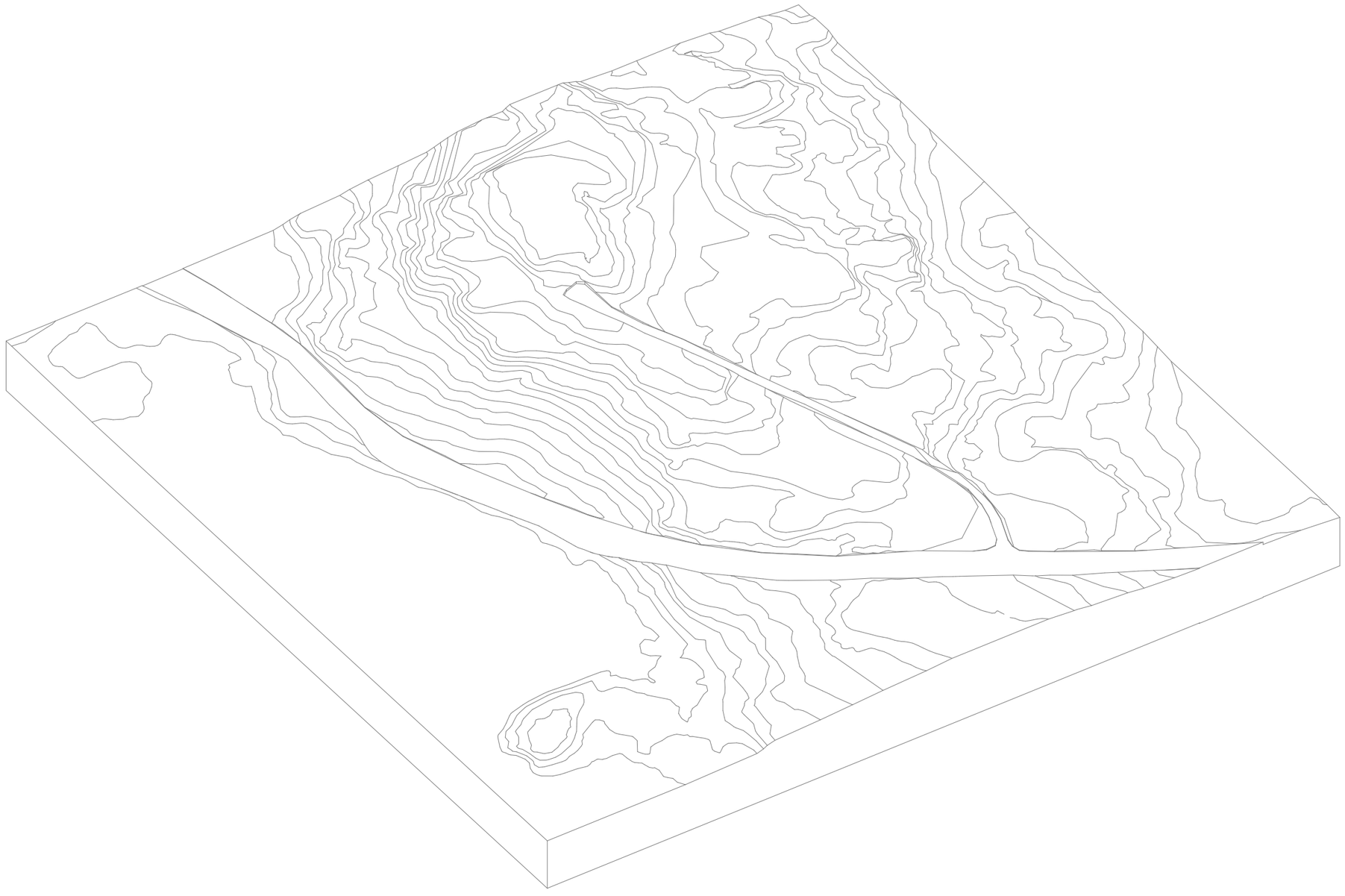
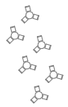
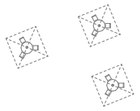


Figure 5.5.1
Isometric view of the original topography.
1:2000

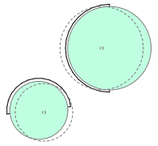
table sets with sockets **1**



individual table sets with canopies and lights **2**



circular bench under trees **3**



moveable step benches **4**

urban stage with step benches as stands **5**

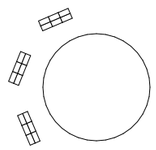


table sets with lights and glass roof canopy **6**

play structure **7**

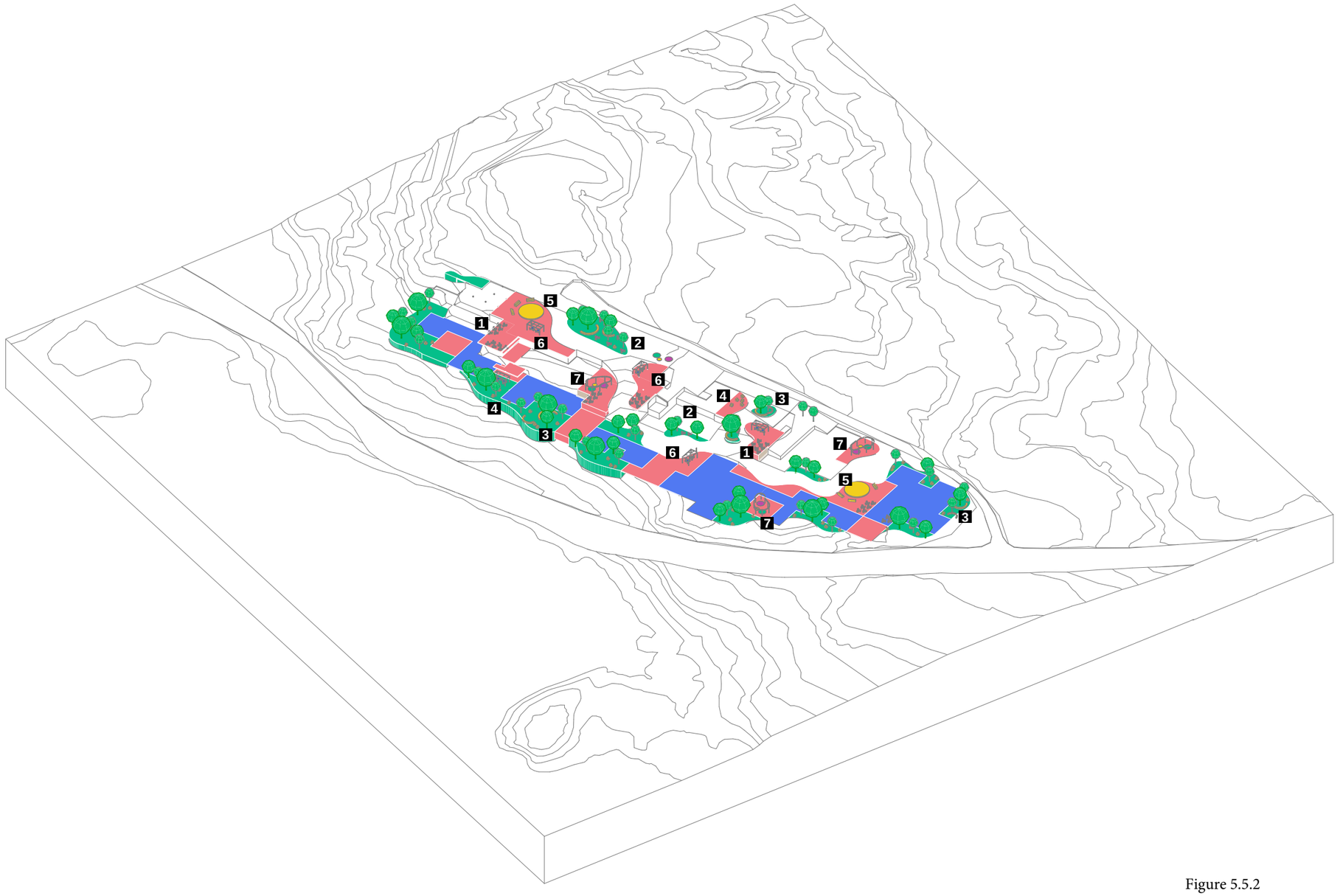
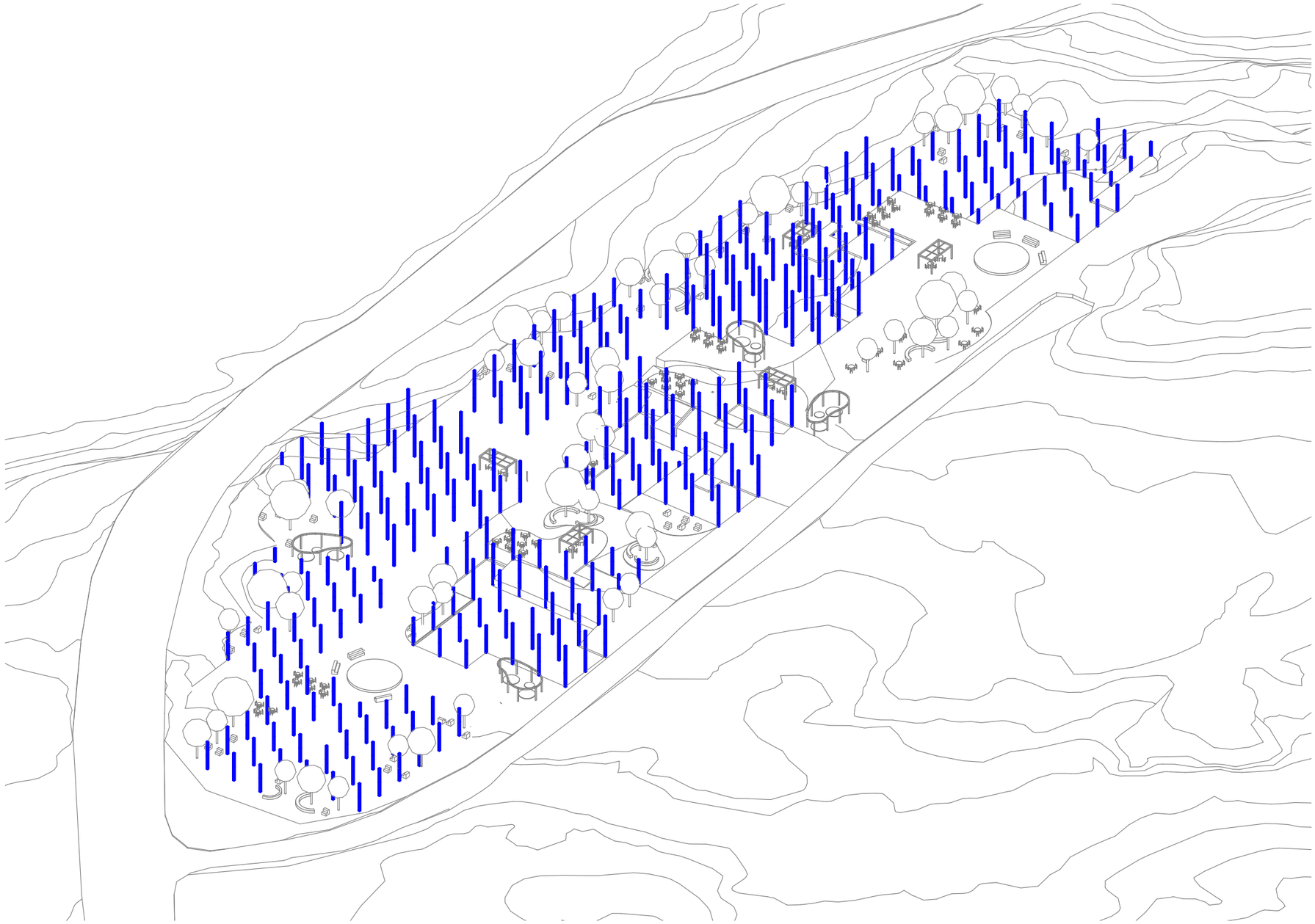


Figure 5.5.2
Isometric view of modified landscape and urban furniture.
1:2000

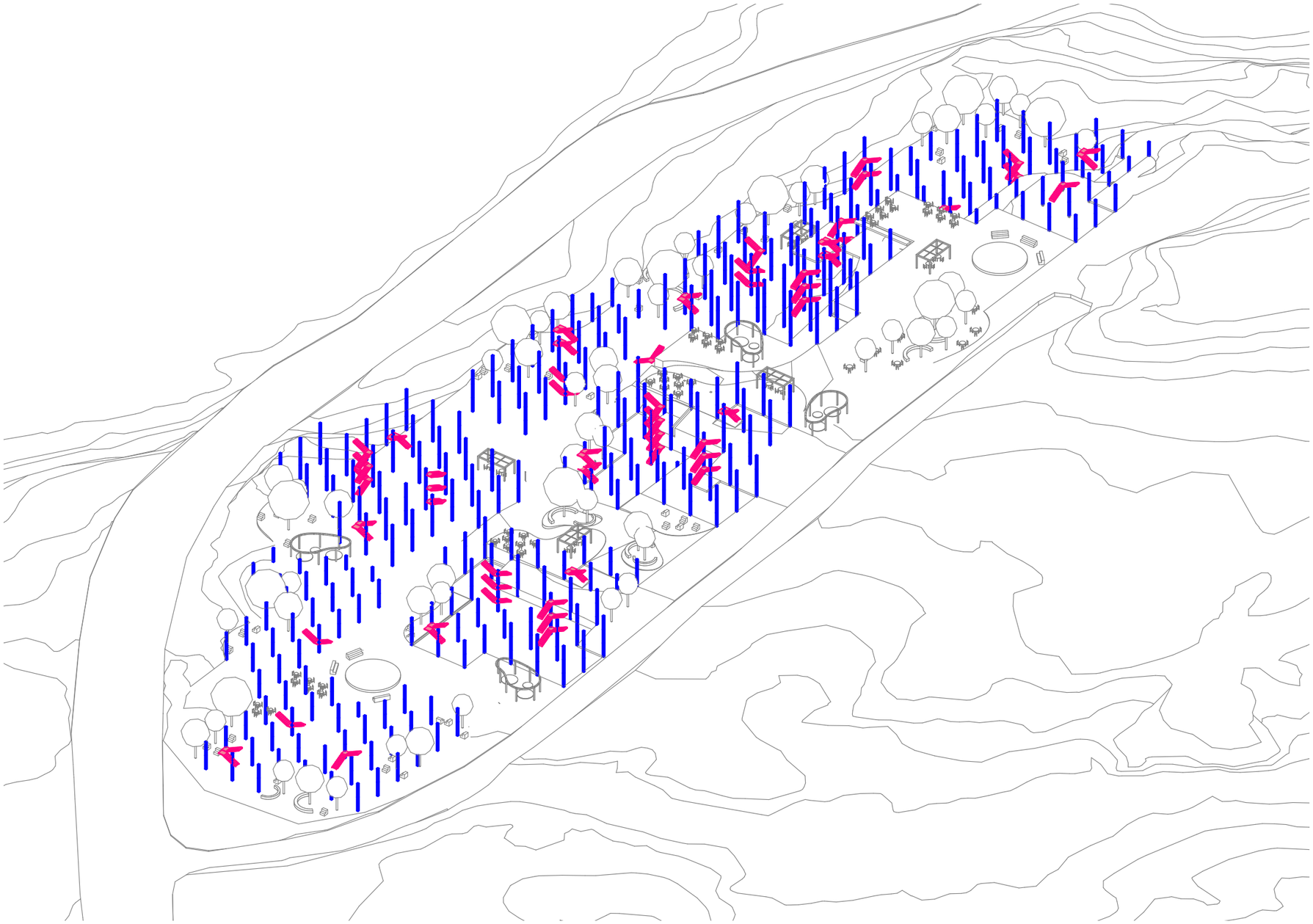
site application
| fixed parts



bearing structure

Figure 5.5.3
Isometric view of fixed bearing structure on site.
1:1000

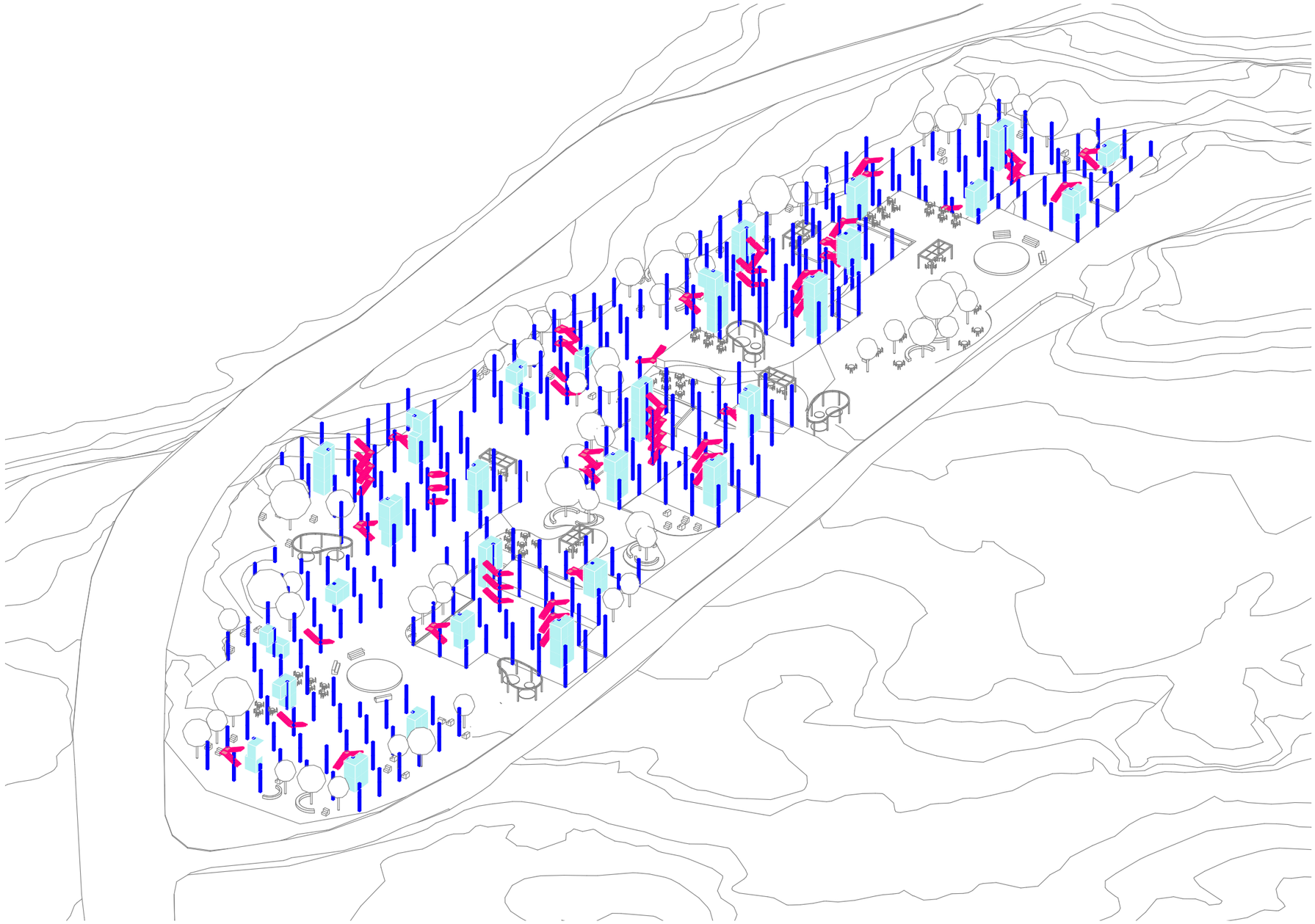
site application
| fixed parts



stairs
bearing structure

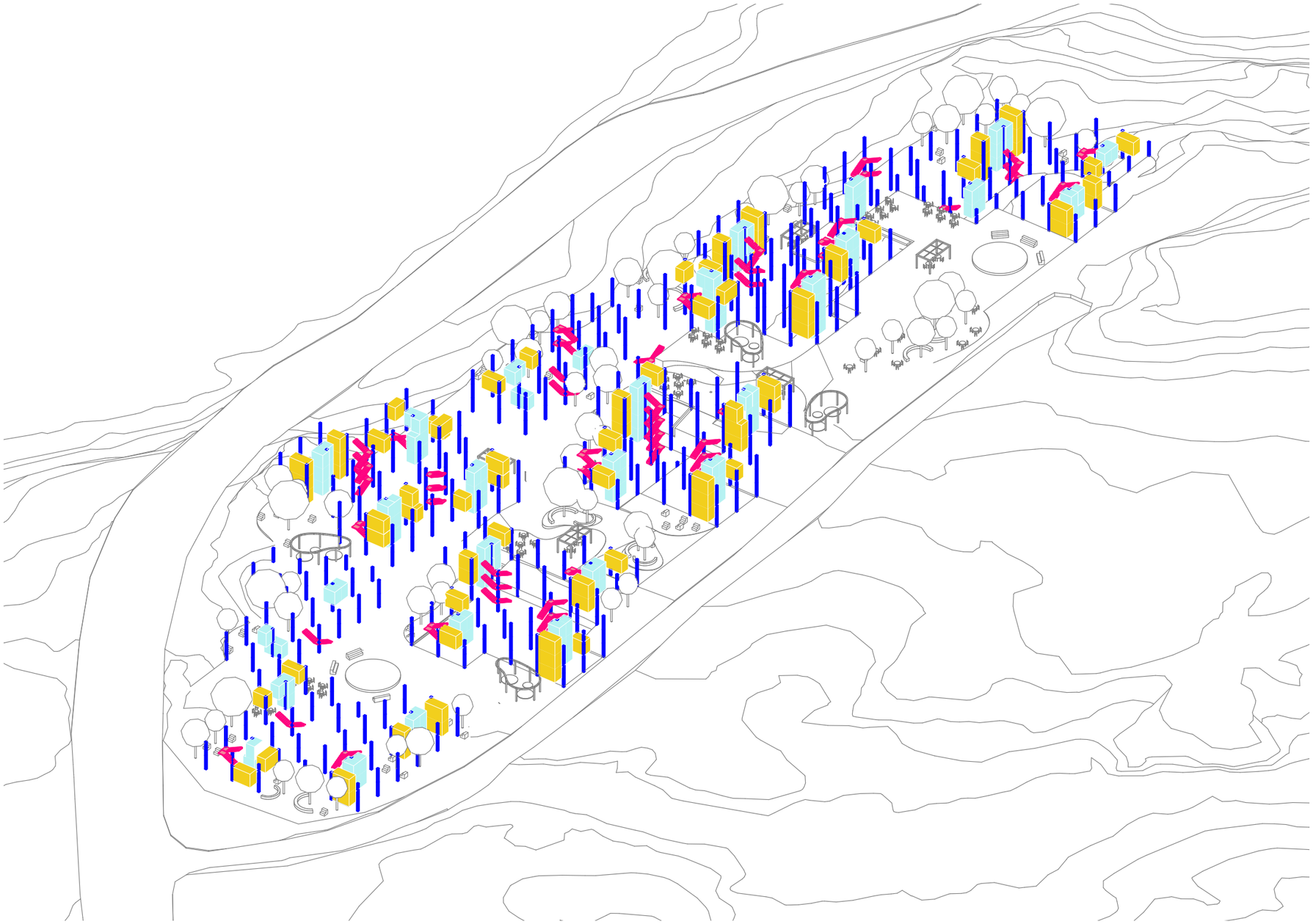
Figure 5.5.4
Isometric view of fixed elements, coloumns and stairs.
1:1000

site application
| fixed parts



wc
stairs
bearing structure

Figure 5.5.5
Isometric view of the fixed parts, columns, stairs and wc.
1:1000



kitchens
wc
stairs
bearing structure

Figure 5.5.6
Isometric view of the fixed parts, columns, stairs, wc and kitchens.
1:1000

the ideal times with no pandemic

With 96 apartments in total, the area for services and small local business take up the highest percentage of the total floor area compared to the other scenarios. In this scenario, certain public spaces are open not only to the residents living in this neighbourhood but also in surrounding areas.

SCENARIO 1

services
small business
apartment
roof garden

Figure 5.5.7
Isometric view of progrmmes combination in the first scenario.
1:1000

pandemic times

High demand for public services like local clinics and separated small indoor shared space for small group activities. With limited access to indoor events, outdoor space for leisure activities and exercise is needed than ever. Some of the small business space such as restaurants and cafe house are turn into public service usages such as open shared office and vaccination points.

SCENARIO 2

services
small business
apartment
roof garden

Figure 5.5.8
Isometric view of progrmmes combination in the second scenario.
1:1000

normal times with low economy

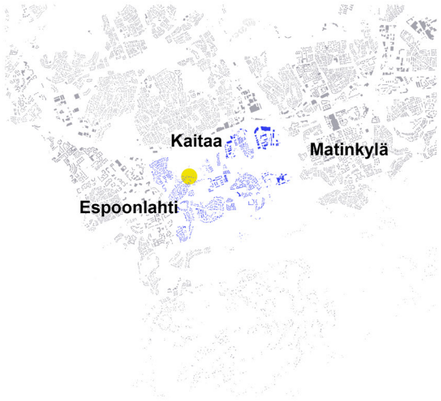
Increasing demand for housing, decreasing spatial need for small business, which space are adapt into housing and services space, as supplys for housing needs.

SCENARIO 3

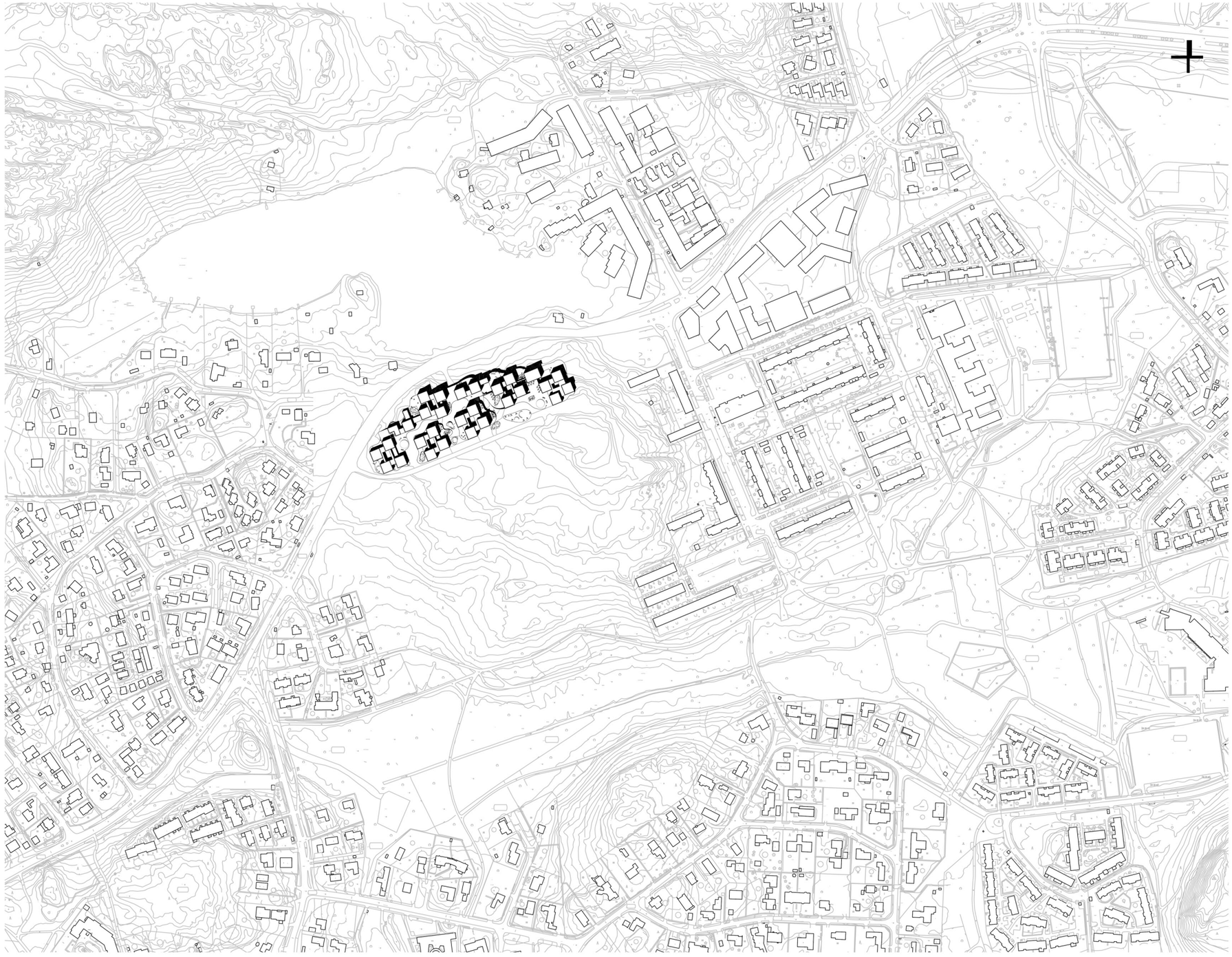
- services
- small business
- apartment
- roof garden

Figure 5.5.9
Isometric view of pro-grmmes combination in the third scenario.
1:1000

site application
| site plan
| scenario 1



Kaitaa area
Site area



Page 120
↑ Figure 5.5.10
Site location.

Page 121
→ Figure 5.5.11
Site plan | Scenario 1
with future planning of adja-
cent plot from city of Espoo.
1:5000

1.krs -3.000
floor plan
scenario 1

Figure 5.5.12
Floor plan | 1st floor.
1:1000

2.krs ±0.000
floor plan
scenario 1

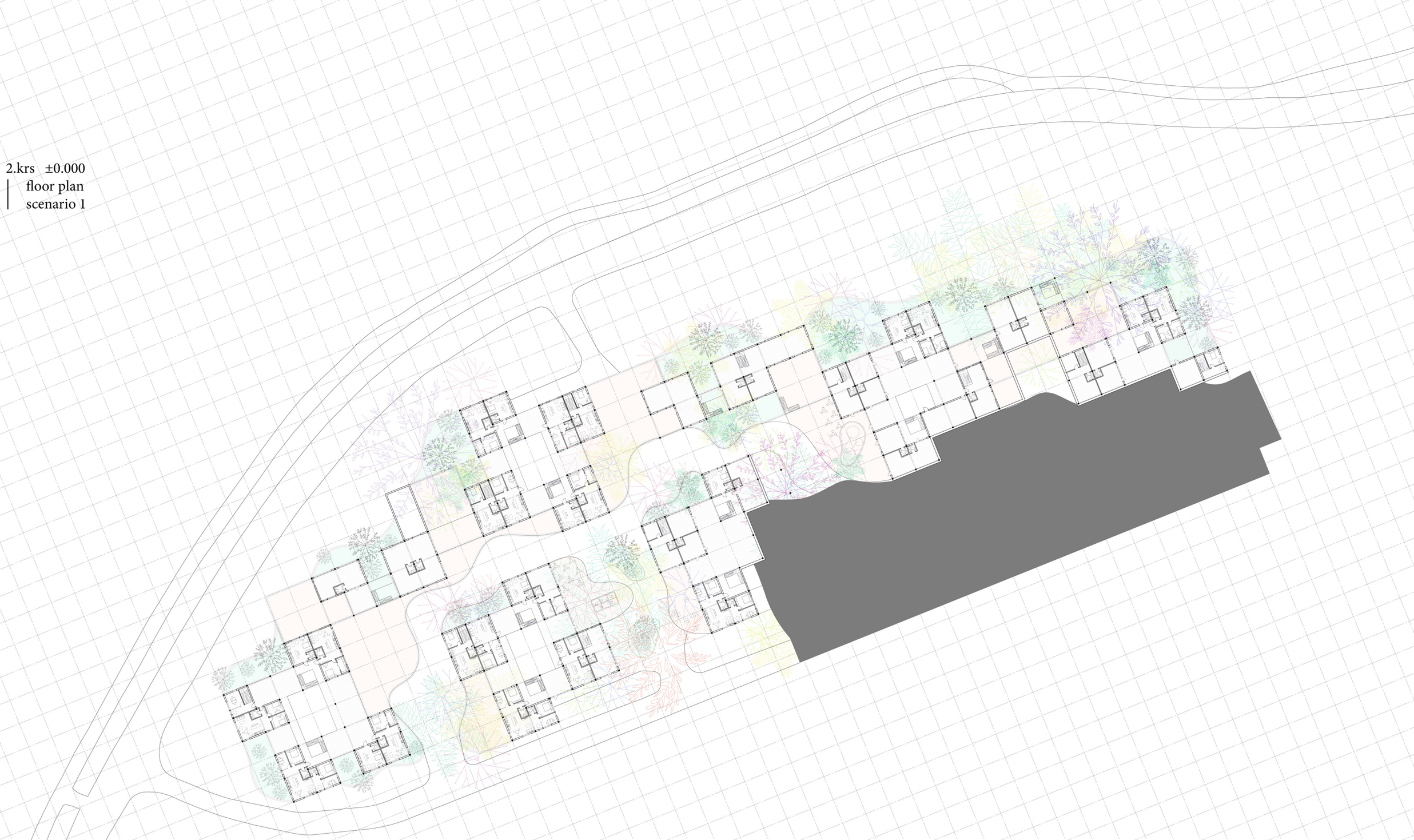


Figure 5.5.13
Floor plan | 2nd floor.
1:1000

3.krs +3.000
floor plan
scenario 1

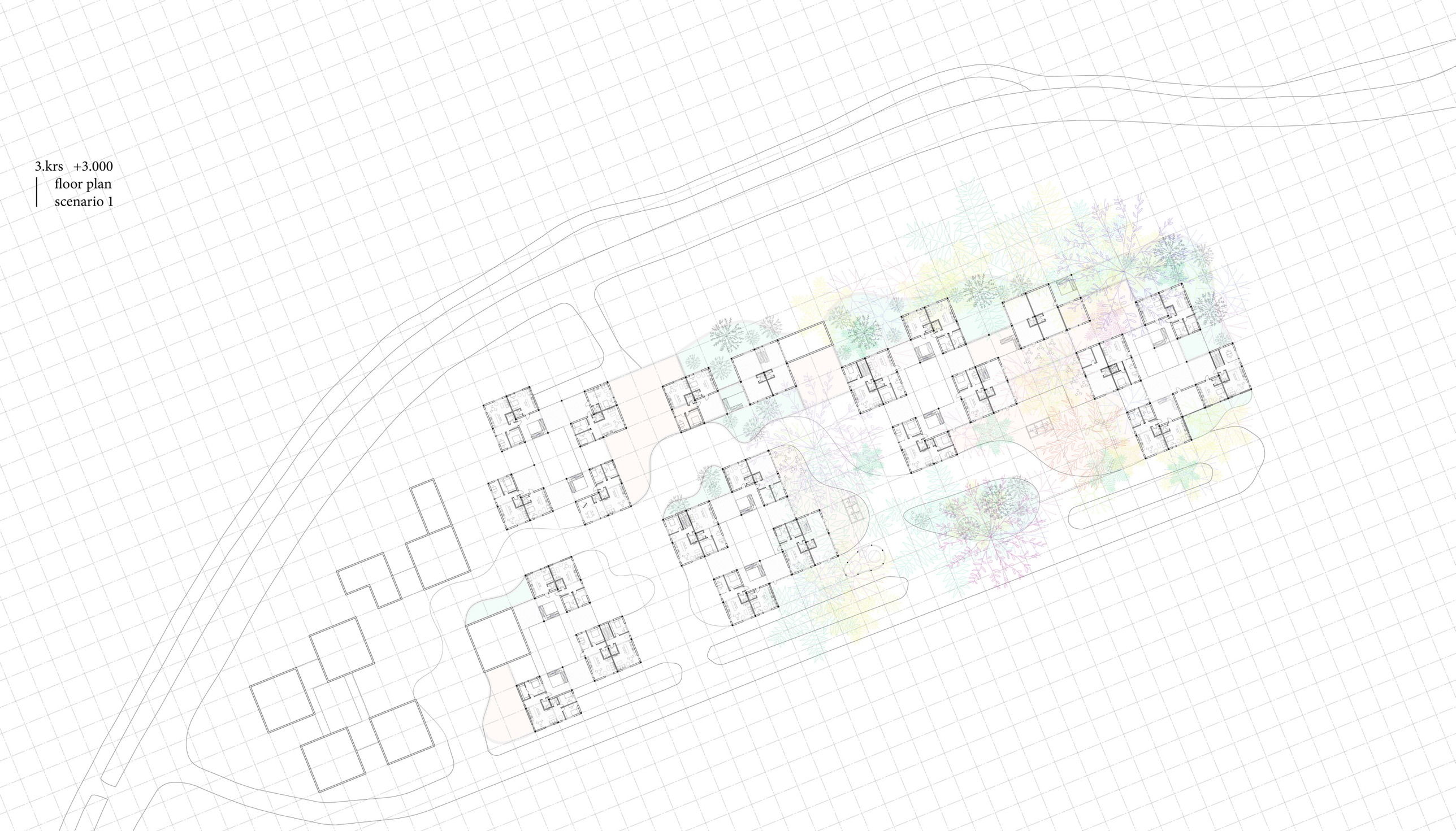


Figure 5.5.14
Floor plan | 3rd floor.
1:1000

4.krs +6.000
floor plan
scenario 1

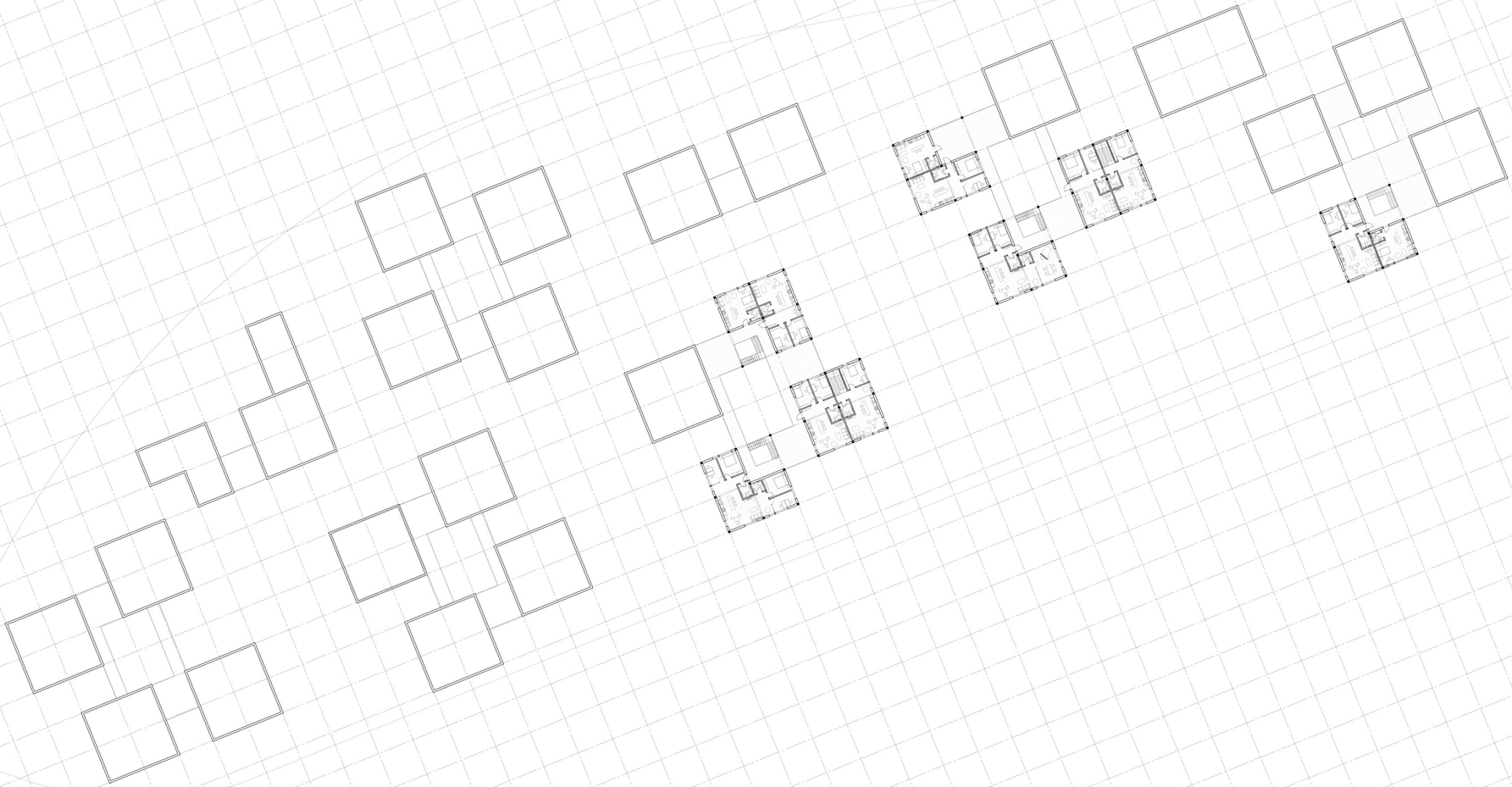


Figure 5.5.15
Floor plan | 4th floor.
1:1000

5.krs +9.000
floor plan
scenario 1

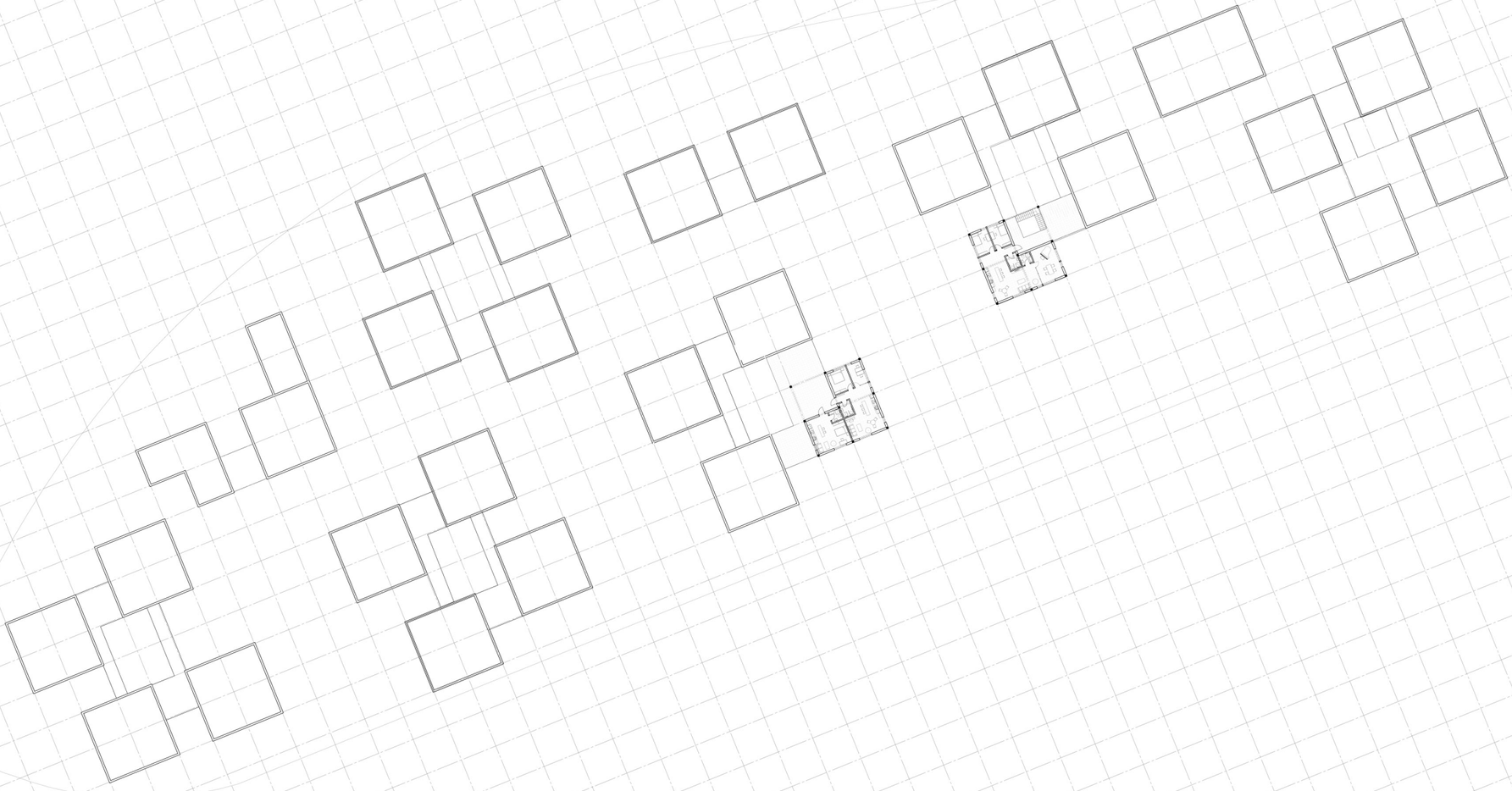


Figure 5.5.16
Floor plan | 5th floor.
1:1000

section A-A part I
| scenario 1

Figure 5.5.17
Section | A-A part i.
1:300

section A-A part II
| scenario 1

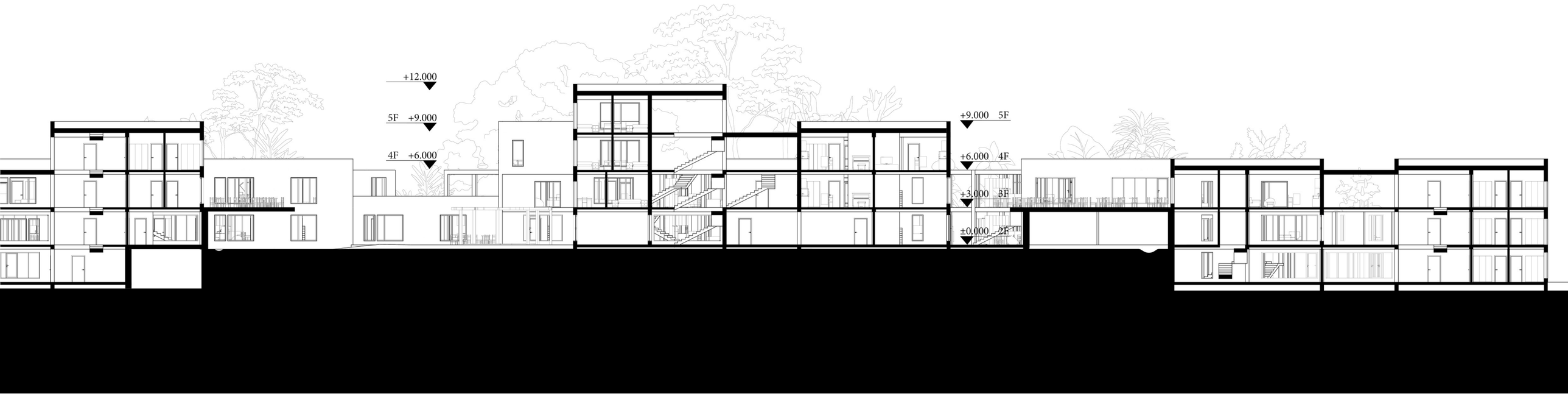


Figure 5.5.18
Section | A-A part ii.
1:300

section B-B
| scenario 1

Figure 5.5.19
Section | B-B.
1:300

northwest elevation
| scenario 1

Figure 5.5.20
Elevation | Northwest view.
1:700

northeast elevation
| scenario 1

Figure 5.5.21
Elevation | Northeast view.
1:300

Figure 5.5.22
Elevation | Southeast view.
1:700

southwest elevation
| scenario 1

Figure 5.5.23
Elevation | Southwest view.
1:300

Figure 5.5.24
Visualization | Scenario 1
Street furniture as events curator;
Plants as distance keeper.

Figure 5.5.25
Visualization | Scenario 1
View of apartment interior.

Figure 5.5.26
Visualization | Scenario 1
View of communal terrace
and indoor shared space.

5.5 CONCLUSIONS

This design proposal depicts a modular pandemic resilient neighbourhood which enables 'normal' and happy life of its residents, in both normal and pandemic times. Taken as a main approach to achieve pendemic resiliency, this design focus on spatial flexibility in three different level of scales, which main spatial elements are as follow:

spatial elements that enables pandemic resiliency

public outdoor spaces with different level of publicness

In different level of publicness - from the main street which is accessible to all the residents to inner courtyard in each housing unit - public outdoor spaces are equipped with multi-functioning urban furniture that welcomes passer-by to stay. The urban stands in the main street, for example, in colour bright pink. See Figure 5.5.12. Its first step can be used as a bench, and its second step is what makes it a stand but also can be used as a table surface for a cup of coffee or some cinnamon rolls with friends.

multi-usage home office space

With glass partition in bright blue frames, it is designed as an individual space with the same priority as other commonly seen domestic rooms, such as bedroom and living room, in many of the apartment types, is one of the main focuses of flexibility design in apartment level. See Figure 5.5.13. As a room that locates always next the bedroom, it could be used as home office, as shown in the figure, under pandemic times, like the one that we are going through, or being included as a part of the bedroom, if the user wishes.

separated indoor shared space

Indoor shared spaces are scattered over the housing blocks in different sizes and different levels of sharedness, as public outdoor spaces. Instead of one single common room that could hold multiple activities at the same time, it is cut into small rooms with different sizes for different activities, see Figure 5.5.14. The number of users per indoor spaces can be reduced significantly by such spatial arrangement compared to one big public room, which would make indoor spared space usable even under pandemic times.

communal terrace as semi-outdoor shared space

Also shown in Figure 5.5.14, with walls only on one side and railings on the other three, it is designed as a semi-outdoor shared space, another important spatial type in this design, which as indoor shared spaces located in every housing blocks. It obtains the quality of good ventilation as outdoor spaces and shadings that keep users away from rain and snow, which makes it an enjoyable place to stay in both normal and pandemic times.

modular system: from Kaitaa to anywhere

Enable such neighbourhood being realized not only in Kaitaa but also in different sites and contexts around the world. Modularly is chosen as the design and construction methods in this proposal, taking its advantages of scalability, flexibility in reconfiguration to different sites and scenarios, and the reusability of its building materials. In this thesis, a modular system - from the scale of apartment layouts to individual buildings to mix-used housing blocks to the entire neighbourhood - is developed. However, due to the limited time frame, this thesis focused mainly on the design level of the system with only a preliminary description of how it works in construction level, on which future study is required. //

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List of figures

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